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ASHRAE JOURNAL

Heating • Refrigerating • Air Conditioning • Ventilating

Department store air conditioning — p. 37

Absorption refrigerants compared — p. 45

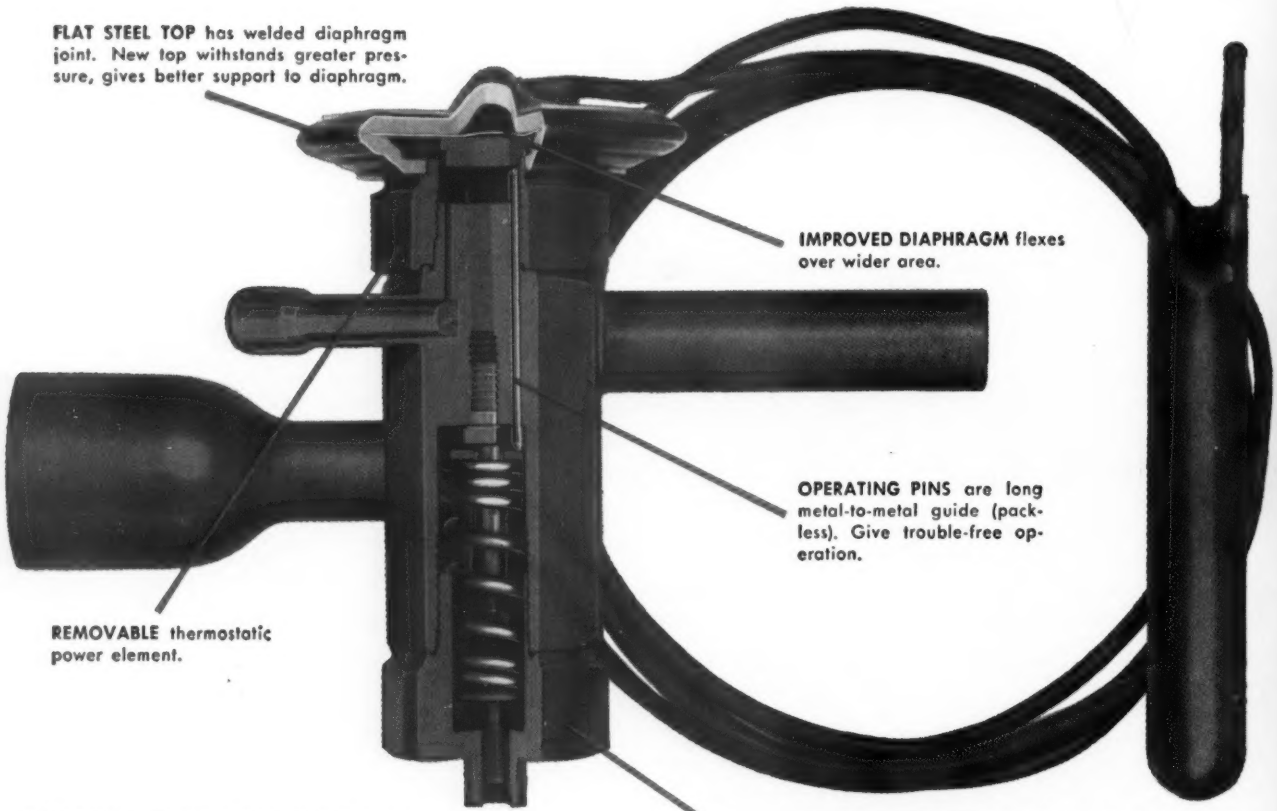
Ventilating problems of the steel industry — p. 41

Holding down refrigerator noise — p. 51

Apple storage system improved — p. 58

DECEMBER 1959

"Flat-top" valve with improved diaphragm withstands over one million normal life cycles



New A-P model 214 "flat-top" thermostatic expansion valve

This new, improved thermostatic expansion valve was built to last and last. In fact, the new model 214 "flat-top" has a life span of over 1,000,000 normal life cycles. It's the ideal valve for trouble-free replacement on large commercial applications.

Just the valve for heat pump applications, too! Sudden withdrawal of high pressure on the outlet side coupled with high thermal bulb pressure was causing tremendous strain on the diaphragm. Result: Life expectancy on some valves used on heat pump applications was as low as 7000 life cycles. CC engineers extended valve longevity with the improvements shown above — features that enable the new "flat-top" to withstand over *100,000* life cycles of extreme pressure fluctuations incurred during heat pump reversals.

The new A-P model 214 is part of industry's most complete line of refrigeration and air-conditioning controls. Take advantage of Controls Company of America's single-source availability — your assurance of dependable performance. Write today for complete details.

Creative controls for industry

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DECEMBER
1959

VOL. 1 NO. 12

OFFICIAL PUBLICATION

ASHRAE JOURNAL

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

FEATURE

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Investigating noise from refrigerator compressors (R) 51
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Apple storage improved by controlled atmosphere system (A) 58
J. W. Zahradnik

Reference letters above refer to areas of interest of ASHRAE members
H—heating, R—refrigerating, A—air conditioning, V—ventilating

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Comment

ASHRAE JOURNAL

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EXECUTIVE SECRETARY

HAPPY BIRTHDAY TO US ALL

It was just a year ago, on December 1, that the members of ASHAE and of ASRE voted to merge to form the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

There have been many problems, foreseen and unforeseen, which had to be solved—some of which are still in the process of resolution. But, it would be difficult to find many in either predecessor group who would deny that the prospects of greater benefits, to the members and to the engineering field with which they ally, were not now considerably brighter than even the most optimistic anticipated when the merger was in the discussion stages.

And those who for reasons of personal interests and fond memories were less than persuaded seem now predominantly to approve and to be supporting actively the programs as formulated.

As an example of fortuitous outcome, the matter of membership is outstanding. A frequent question in pre-merger days was keyed to loss of total members due to disaffection or overlap between the groups. A year ago our membership was 18,344. Today it is 19,113. A clear gain of 4.2% with the shakedown stages quite well passed.

Again, it was predicted that we might anticipate a total circulation for the ASHRAE JOURNAL of 20,000 within a reasonable interval after the two societies merged. This issue is distributed to 23,500 members and subscribers.

Yes, Happy Birthday.

CHAIN OF SUCCESSION

In each issue, beginning with July of this year, President Hess followed by the other officers is defining explicitly the overall program of ASHRAE and comparative details of headquarters administration, regional operations, chapter strength, publications, technical coordination, finances and program planning.

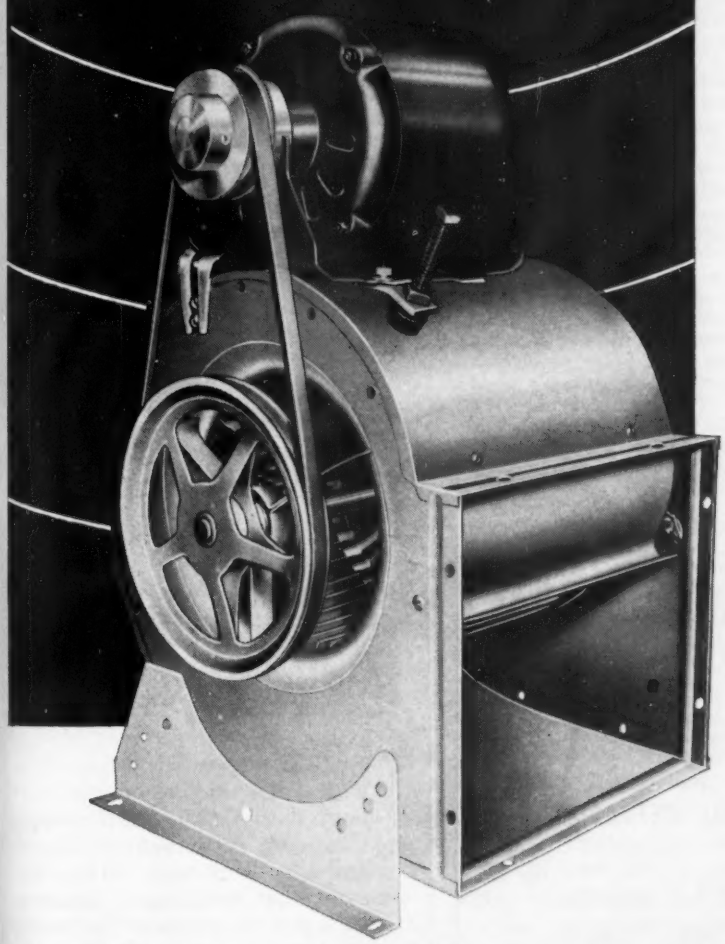
The facts are there. Every member should be well informed about them.

It is true that under the Consolidation Agreement, which is preeminent in the succession of officers and their terms for the interval to June 1962, a series of fairly rapid changes is provided.

Each group serves a nominal half year until June 1961. The customary annual term of office is foregone. The accomplishment of each successive administration must be brought about within a relatively brief interval. Thus, changes could be abrupt and even short-lived but nothing disruptive in any sense is likely, for the unity of purpose and objectives of the officers of ASHRAE is directed clearly toward a single constructive end; that of a strong professional engineering Society, serving its members, its engineering fields and the public interest undeviatingly.

Edward R Searles
Editor

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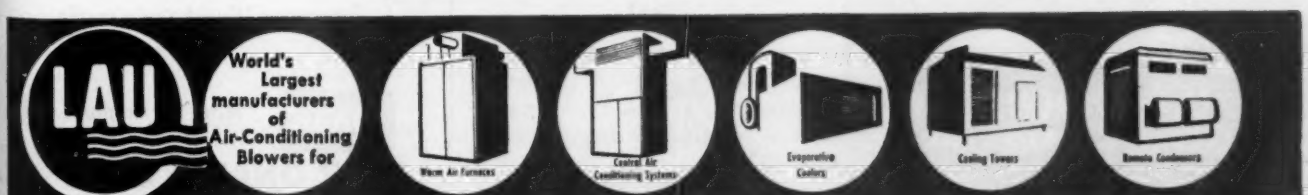
Series A blower assemblies are recommended for warm air furnaces, central air conditioning systems, evaporative coolers, cooling towers, and remote condensers.

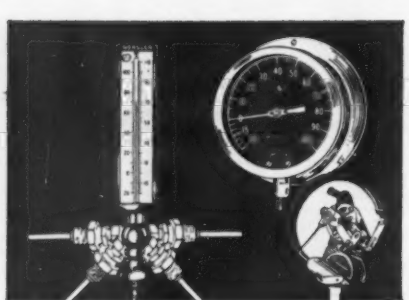
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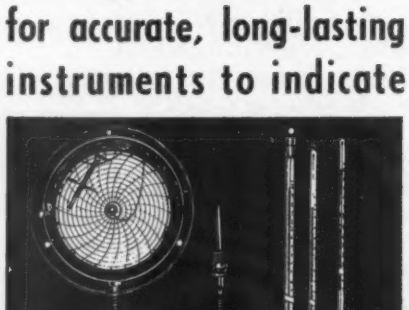




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Now that you mention it—

. . . ALARMING . . .

To the Editor:

I found your editorial in the August 1959 issue of the ASHRAE JOURNAL almost as alarming as you apparently find the trend toward increased research and the ever increasing body of knowledge that threatens to inundate us. You seem to propose that we sidestep rather than confront the problems of our dwindling reservoir of fundamental knowledge and of the effective and efficient documentation and retrieval of information and data.

No one likes to see wasted effort. In basic research this may be inevitable; in applied research, we should do better. In applied research we should try to avoid developing information so far in anticipation of society that it may become dust covered before acceptance is feasible and developing information that is no longer needed.

What we need is a sharper focus on our most perplexing problems, the solution of which will find application in our time. In addition we need a much heavier concentration on fundamental or basic research so that we will not be forced into crash programs of high cost when the need is suddenly upon us. Finally, let's confront the problem of storage and retrieval of information as a scientific and engineering problem before the tide of information may have swept over us.

ROBERT M. DILLON
Executive Director

Building Research Advisory Board
National Research Council
Washington, D. C.

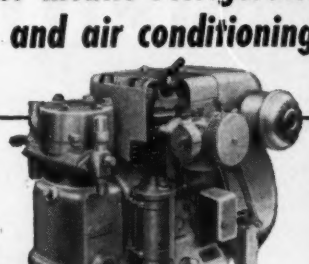
We said "The goal should be usable facts. The flood must be dammed for storage somewhere for the record."

ASHRAE
NATIONAL MEETINGS AHEAD

1960
Feb. 1-4 Semiannual
Dallas, Texas
June 13-15 Annual
Vancouver, B.C.

1961
Feb. 13-16 Semiannual
Chicago, Ill.
June 26-28 Annual
Denver, Colo.

Onan
ENGINE COMPRESSORS
for mobile refrigeration and air conditioning



AJ4MC — 1 ton cap., 4.1 H.P., F-12 refrigerant.



LK5MC — 2½ tons cap., 6.25 H.P., F-22 refrigerant.



CCK11MC — 5 tons cap., 12.9 H.P., F-22 refrigerant.

Built as integrated in-line units with Onan engines direct-connected to Onan compressors. Compact, permanently-aligned and smooth-running. No troublesome belts, couplings or sheaves. Optional accessories: batteries, starters, generators, and fans. Onan 4-cycle engines, built for continuous duty and long life, operate on either gasoline or Propane. World-wide parts and service organization.

Onan ELECTRIC PLANTS

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Late news highlights

"Sputnik fever" Declining engineering enrollments were blamed on "Sputnik fever," which hit the United States two years ago and may have diverted potential engineers to study science, by Dean Dale R. Corson of the Cornell University College of Engineering, who noted an average decrease of 11% throughout the country in freshman engineering enrollments in the fall of 1958. Dean Corson also cited the increasing difficulty of attracting people into teaching of engineering because of competition with high salaries offered by industry.

Reference on oscillations A bibliography on combustion-driven oscillations, edited by Abbott Putnam and Carl Speich of Battelle Memorial Institute, includes more than 550 references to literature on pulsations and noise associated with combustion. Covering literature published from 1940 to the summer of 1959, the bibliography represents a comprehensive set of references and lists centers of work and individuals prominent in this field of study. Copies may be obtained without charge from the Publications Office, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

Programs of study Beginning next September, Northeastern University in Boston, Mass., will offer an evening program of studies in engineering leading to the degree of bachelor of science in electrical engineering. Additionally, the Graduate School will offer four master of science degree programs in engineering on the Co-operative Plan of Education, whereby students alternate ten-week periods in the University with periods of equal length on regular jobs in business and industry.

Scandinavian show Probably the largest show of its kind in Scandinavia, with 150 firms displaying products, the Exhibition for Heating, Ventilating and Sanitary Engineering took place in Stockholm, October 16-25.

Industrial noise Providing information especially pertinent to the industrial hygienist, *Industrial Noise Manual* covers the physical characteristics of noise, its measurement, its effect on exposed persons and its control. Included are chapters on physics of sound, instruments for measurement and audiometry, technique of sound measurement, procedure of a noise survey, calibration, how we hear, effects of noise, engineering control of noise and personal protection in noise control. The book, first of a series of planned manuals covering important industrial hygiene subjects, is available from the American Industrial Hygiene Association, 14125 Prevost, Detroit 27, Mich., price is $7.50.

Survey of juniors In its second annual survey of "Junior Year Science and Mathematics Students" (U. S. Department of Health, Education and Welfare, Cir. No. 577), the Office of Education found that the number of college juniors majoring in science and mathematics increased 10.4% between the fall of 1957 and the fall of 1958; the total majoring in science and mathematics represents 13.8% of all junior students. The number of engineering students was 2.5% lower than the preceding year. Combined junior enrollments in engineering and science, including mathematics, comprise 25% of the entire junior student body.

Diamond jubilee 1960 marks the 75th Anniversary Year of automatic oil heating. Theme adopted by Oil Heat Institute for the anniversary year, "75 years of carefree comfort – Oil Heat's Diamond Jubilee," will be used for the Institute's 38th Annual Convention and for the concurrent Heat and Air Conditioning Exposition at the New York Coliseum, April 4-7, 1960.

Comfort in theaters Seven Manhattan theaters (Shubert, Broadhurst, Majestic, Booth, Plymouth, Royale and Golden) will be mechanically air conditioned for the first time by next summer, theater owner J. J. Shubert and Worthington Corporation have announced. A hook-up will link all seven theaters to a master air conditioning system, a 650-ton central refrigeration plant installed beneath Shubert Alley. The theaters, with a combined 7,999 seats, make this one of the largest single theatrical air conditioning installations. According to Worthington, the new system, which replaces an old ice-chilling method, will cost one-tenth as much to operate and will regulate humidity and provide other advantages.

Systems of units Four discussions on national and international aspects of systems of units are included in the program of the American Association for the Advancement of Science annual meeting, Section M – Engineering, to be held December 28-29 in Chicago, Ill. – The Confusion of Chaos in Units, Carl F. Kayan presiding; Public Education vs. the Consumer Public, H. C. Diehl, presiding; Problems of Design, Manufacture and Commerce, Robert J. Painter presiding; and The Look to the Future, Clarence E. Davies presiding.

Heating homes "Facts About Fueloil and Home Heating," a 24-page pamphlet published by the National Fueloil Council, 424 Madison Avenue, New York 17, N. Y., provides up-to-date information and data on home heating in the United States, including descriptions of the three major heating fuels; trends in major home heating fuels up to the present, present position and future trends; a comparison chart of the major heating fuels and a statistical summary of oil-heating by states.

Resistance heaters added Unitary Equipment Div. of Carrier Corporation will expand its distribution of electric heating products from heat pumps to include two complete lines of electric resistance heating equipment, according to Russell Gray, vice president and division general manager.

More thermoelectric devices Development of four new thermoelectric devices has been announced by Whirlpool Corporation. These include a compact water purification apparatus which uses thermoelements simultaneously for evaporating and condensing and a multi-compartment food cabinet for long range aircraft personnel. The latter holds pre-cooked meals in a frozen state until a few minutes before serving time when, by reversing the electric current flow through the thermoelements, the refrigerated compartment containing the individual meal becomes an oven and heats the meal to serving temperatures without affecting other frozen foods in the cabinet. Two other devices utilize the principle of the thermocouple; in one an electric current generated directly by otherwise wasted heat operates a Sprengel type mercury pump suitable for gases and liquids and in the second a thermal junction and mercury are used to operate gas or fluid valves.

Subsidiary General Waterworks Corporation has signed an agreement to acquire the Frick Company; however, operations will continue under the same name and most of the same staff but as a subsidiary of the General Waterworks Corporation. Dr. Norris Benedict, retiring president of Frick, stated that the offer was accepted by the Frick Company stockholders because it met their requirements for a tax-free exchange and for a more liquid security of a company which would continue and expand the Frick business in Waynesboro.

Oil burner research Substantial progress in establishing a petroleum industry program of oil-burner research has been reported by the American Petroleum Institute, which indicates that research is now under way in the following areas – atomization of fuels, fuel-air mixing, catalytic and surface combustion, combustion acoustics, new fuel-oil uses, new types of burners and modification of existing burners.

NOTICE TO MEMBERS OF 1960 SEMIANNUAL MEETING

The Semiannual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., will convene at Dallas, Texas at 9:00 a.m., Monday, February 1, 1960.

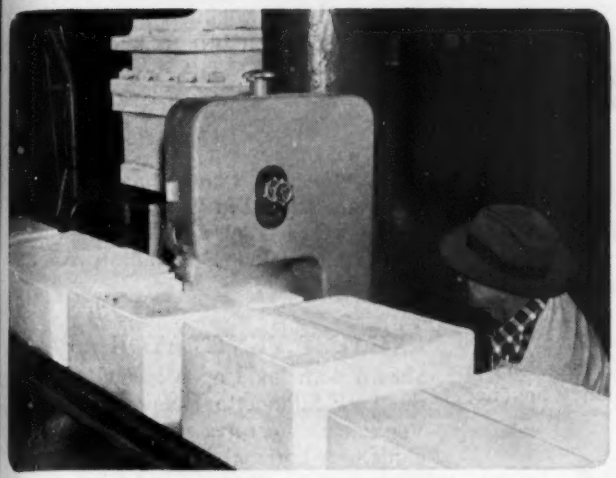
Continuing through Thursday, February 4, the meeting will include Technical Sessions covering Absorption Refrigeration, Heating, Thermoelectric Refrigeration, Sound and Heat Transfer. There will be a Domestic Refrigerator Engineering Conference on the use of plastics; others on Commercial Refrigeration, Fenestration, Window Air Conditioners and Automotive Air Conditioning.

New officers will be installed at the Welcome Luncheon on Monday, February 1.

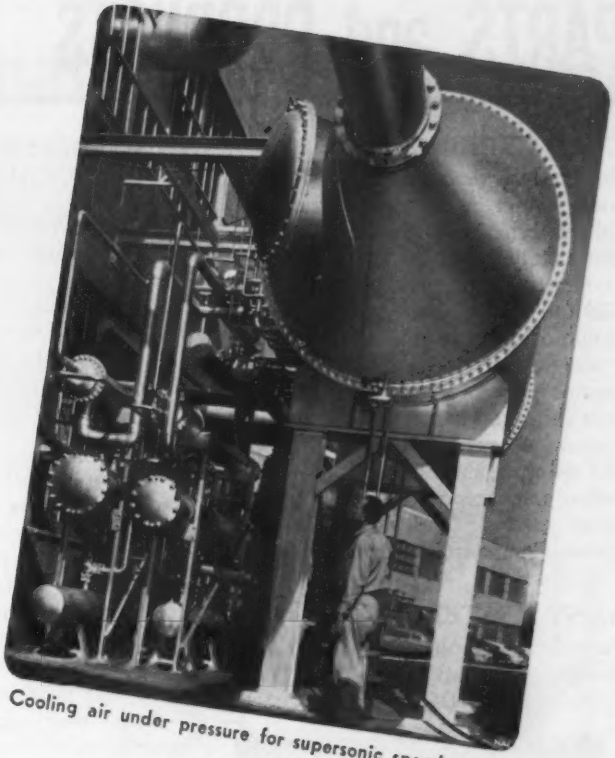
Every member who can do so should plan to attend the Dallas Meeting.

A. J. HESS
President

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Making dry ice at 109° below zero using standard ammonia compressors in an improved cycle.



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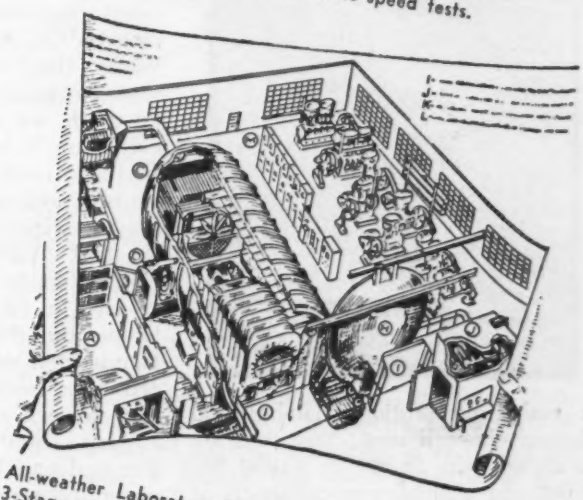
to solve your most difficult cooling problems.

If you need any type of industrial or commercial cooling—for quick freezing, cold storage, ice making, humidity control, low temperatures, condensing, air conditioning, or any process work—contact the nearest Frick Branch or Distributor for recommendations and estimates.

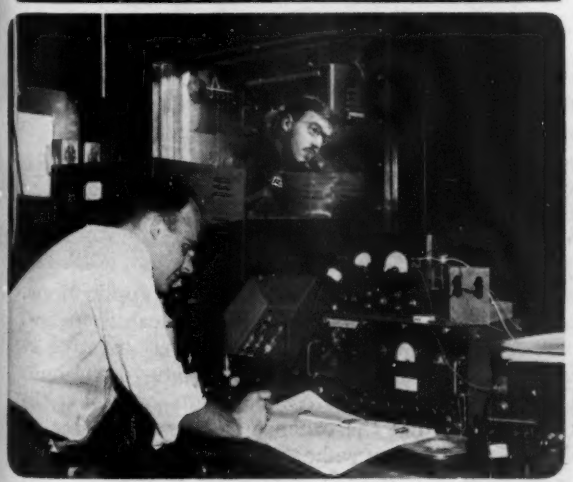
DEPENDABLE REFRIGERATION SINCE 1882

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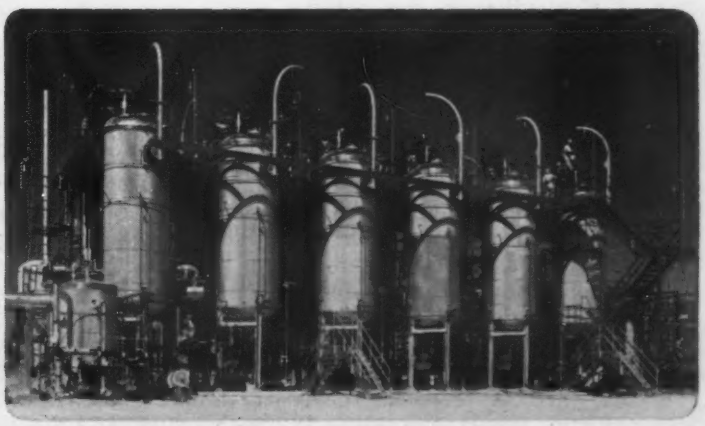
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All-weather Laboratory built for U. S. Army. Uses 3-Stage compressors; maintains Arctic, tropic and stratospheric conditions.



Test laboratory work for temperatures down to 140° below zero.



Frick patented cooling coils and controls have doubled the output of synthetic rubber reactors.

PARTS and PRODUCTS

COLD GENERATOR

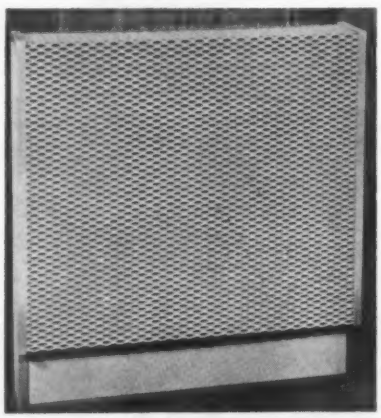
Powered by low-pressure steam and using water as the refrigerant with lithium bromide as the absorbent, this completely hermetic absorption cold generator has capacities from 100 to 350 ton and is equally well suited for single or multiple unit installations.

Single-shell design and hermetic pumps prevent air leakage to maintain full-rated capacity and resist corrosion. A vacuum bottle principle of the external shell design makes insulation unnecessary for most installations.

Trane Company, La Crosse, Wisc.

VENT HEATER

Intended to replace un-vented space heaters, the Safti-Wall Vent Heater introduced by this manufacturer has



a sealed combustion chamber and through-the-wall vent. Two sizes are available, with 28,000 or 33,000 Btu input and manual, semi-automatic or automatic controls. Designed for installation flush with the floor or above the baseboard, and sized for under-window use, they use outside air only for combustion and discharge all products of combustion to the outside through a draft-proof vent cap.

Pioneer Manufacturing Company, 3131 San Fernando Rd., Los Angeles 65, Calif.

TEMPERATURE CONTROLS

Two temperature controls, 3ART-5 for domestic and commercial refrigeration systems and 3ART-15 for room air conditioners, have been introduced by this manufacturer. Powered by a short-stroke bellows charged with refrigerant gases, the small cold controls are cited as producing quick and accurate temperature changes. The gas-filled bellows operates against a lever and coil spring, making or breaking contact with a bounce-less action.

Model 3ART-5 is rated at 10/5 amp, 120/240 volt at full load and 60/30 amp, 120/240 volt with locked rotor; Model 3ART-15 at 16/8.4 amp, 120/240 volt at full load and 90/60 amp, 120/240 volt with locked rotor.

General Electric Company, Schenectady 5, N. Y.

RELIEF VALVES

Expansion of its relief valve line to include 2 new models enables this manufacturer to offer 10 models with either ½ or ¾-in. male inlets. With automatic reset models 498 and 499, this line now includes two pressure, four temperature-pressure and four automatic models.

Both new units, for protection against excessive pressures and temperatures when inserted in hot water lines or tanks, are furnished with six-in. extension tubes which provide contact with the hottest water in the tank. Valves close automatically after a 10 F temperature drop. Constructed with red brass bodies, they have a rating of 150,000 Btu and can be adjusted to relieve water at any pressure between 50 and 200 psi.



Illustrated is Model No. 499.

Mansfield Sanitary, Inc., Perrysville, Ohio.

TEMPERATURE REGULATORS

Vapor-pressure operated, these regulators, for use on water heaters, fuel oil pre-heaters, fuel oil coolers and storage tanks, are designed to control the flow of either heating or cooling fluids. Depending upon the application, they can be supplied as either direct-acting for heating applications or reverse-acting for cooling applications.

Series Type TC is available in bronze bodies in sizes from ¼ to 2 in., with union connections, and in iron or bronze bodies from 2½ to 5 in., with 125 psi ASA flanged ends. Temperature ranges, in 40 deg increments, are available from 25 to 385 F. Series Type TCX is available in sizes from ¼ to 2 in., with bronze bodies and union connections. A wide range regulator, this series is available in ranges from 50 to 310 F, in 70 deg increments. Capillary tubing, cable, temperature bulbs and wells for both series are offered in various metals.

A. W. Cash Valve Manufacturing Corporation, 666 E. Wabash Ave., Decatur, Ill.

EXHAUST VENTILATOR

Shown with hood open and closed is the Low Silhouette Hooded Exhaust Ventilator. Features of this unit include near horizontal discharge to prevent roof damage, motor isolation mounts, integral base and fan inlet, hinged head and tubular bracket on



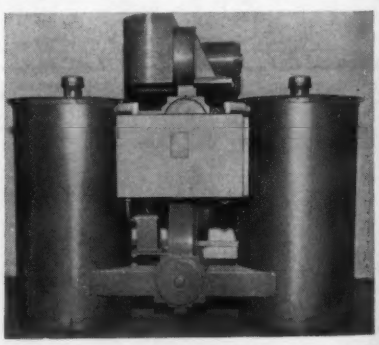
larger models, venturi throat to decrease turbulence and optional screens and safety disconnect switches.

Motors are mounted below the venturi to insure an unobstructed air-stream discharge. Standard construction is of heavy gauge steel, but this ventilator is also available in aluminum and non-corrosive glass fiber construction.

Western Engineering and Manufacturing Company, 4114 Glencoe Ave., Venice, Calif.

INDUSTRIAL DEHUMIDIFIER

Handling as much as 700 cfm, the A75 can remove up to 300 lb of water in 24 hr. Used originally for controlled humidity storage, the "A" line of dehumidifiers is now also utilized

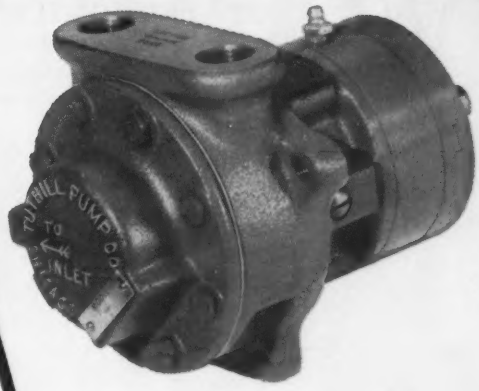


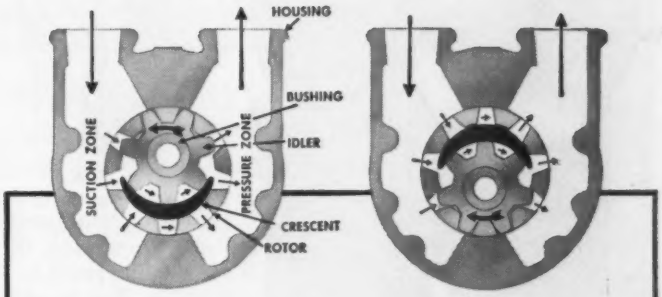
for dry air in processing applications, humidity control in unheated spaces, low temperature installations, and in combination with cooling equipment for lower cost humidity control without the expense and complications of using re-heat.

Plug-in installation of this self-contained, completely automatic unit is

TUTHILL automatic reversing pumps

- **Positive reversing action**
- **Require no valves**
- **Port positions remain constant**





COUNTER-CLOCKWISE ROTATION

CLOCKWISE ROTATION

The model RCK above is typical of Tuthill's complete line of automatic reversing pumps . . . which use the time tested operating principle at the right to provide instantaneous, positive reversing action without the use of valves. The port positions remain constant regardless of the direction of shaft rotation. And all pumps provide uniformly high efficiency in both flow directions.

The automatic reversing design was developed by Tuthill for applications where the pump must be driven from a reversing shaft, or where machinery must be shipped without knowing the ultimate direction of the driving unit. These pumps have been enthusiastically accepted by designers and have proven their dependability in thousands of demanding applications such as large air compressors and machine tools.

375 Models

A complete selection of 375 models is provided with capacities from ⅓ to 200 gpm; for pressures to 400 psi; and speeds to 1800 rpm. Included are a complete assortment of stripped models specially developed for incorporation into manufactured products.

A 12-page catalog, No. 105, gives complete information on all Tuthill automatic reversing pumps. Write today for your copy. Or, if you desire, send drawings so that Tuthill's engineers can show you how the Model R reversing pump can be built directly into your product.

THE PUMPING PRINCIPLE

Tuthill automatic reversing pumps are based on the use of a rotor, idler gear and a crescent shaped partition which is integral with a moving part called the Idler Carrier.

Figure 1 shows how power is applied in counter-clockwise rotation to the rotor and transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the inside diameter of the rotor is sealed by the crescent. When the pump is started there is an increase in volume as the teeth come out of mesh. This creates a partial vacuum, drawing the liquid into the pump through the suction port. The liquid fills the spaces between the teeth of the idler and rotor and is carried past the crescent partition to the pressure side of the pump. When the teeth mesh on the pressure side, the liquid is forced from the spaces and out through the discharge port.

When the shaft rotation changes from counter-clockwise to clockwise, the idler carrier (including the idler gear and crescent) automatically rotates 180° through the suction zone to the position shown in Figure 2 which *changes the direction of flow within the pump* without changing port positions. The idler carrier rotates in a cover casting fitted with stops so that the crescent can rotate only 180°—always through the suction zone. Upon resumption of counter-clockwise rotation, the crescent will swing back to the original position in Figure 1.

Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities From ⅓ to 200 GPM; for Pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

969 East 95th Street, Chicago 19, Illinois

NFPA NATIONAL FLUID POWER ASSOCIATION

WHAT'S YOUR A.M. PROBLEM?



A.M. (Air Movement) is a source of new and bigger problems for the air conditioning, heating, ventilating and refrigeration manufacturer. However, we have an answer for one of your headaches —a *reliable* source for blower housings. DE-STA-CO offers you all these advantages:

- Low unit cost. Our standard high production dies (no tooling cost) are ready to turn out *any* large or small quantity.
- Complete assemblies or parts. Our method assures low costs either way.
- Broad range. For wheels 3¼" to 9⅝" diameter, all widths.
- Fast delivery. Many in stock, both parts and assemblies.
- Adaptations often practical. For your special purpose housing consult us on a variation of a DE-STA-CO Standard and SAVE!

Write for literature and prints or send us your drawings and quantity needed.

A DE-STA-CO Product

DETROIT STAMPING COMPANY

386 Midland Avenue • Detroit 3, Mich.

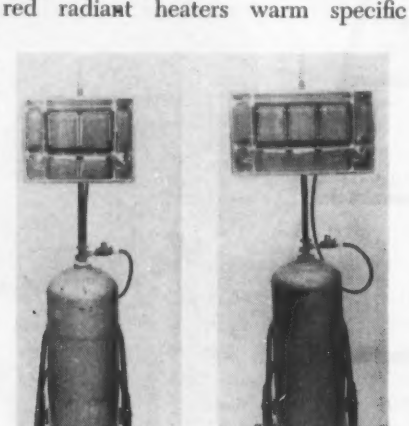
Serving air conditioning, refrigerating, heating and ventilating industries for 40 years

featured, with a minimum of moving parts and thermostatically-protected heaters.

Universal Dynamics Corporation, Box 9814 A, Arlington 9, Va.

INFRA-RED HEATERS

Operated outdoors or inside on bottled propane gas, portable gas-fired infrared radiant heaters warm specific



areas without heating the surrounding air. Three sizes of these heaters are available, rated at 16,000, 24,000 and 36,000 Btu input.

Perfection Industries, Div of Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

HIGH TEMPERATURE COOLER

Offering extremely low headroom architectural flexibility, the Tri-Way Spasaver unit, intended for rooms over 34 F, may be ceiling suspended, sidewall positioned or corner mounted. Nominal capacities of the seven-model series range from ½ to 2 ton. Noted as a special feature is inclusion of a heat exchanger mounted within the unit.

Drayer-Hanson Div, National-U. S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

FLOAT VENT VALVE

Intended for pressures up to 35 psi, Model 200 has a silicone seat that prevents metal-to-metal contact and a nickel-plate finish to impede corrosion. It is designed for any gravity or hot water heating system or chilled water cooling system.

Dole Valve Company, 6201 Oakton St., Morton Grove, Ill.

VARIABLE PROGRAMMING

Developed to control and change the sequence of functions in automatic equipment where several functions must be performed in sequence, this circuit has as its basis a rotary selector using an inverse-homing, tab-type control wafer switch. In conjunction with a hold-in resistor, the control wafer will cause the selector, when impulsed, to skip over unwanted positions. Variations in positioning of the selector are accomplished by placing a toggle switch between the hold-in resistor and each homing contact. An open toggle switch permits the selector to step past that position automatically when the impulse switch is closed.

G. H. Leland, Inc., 123 Webster St., Dayton 2, Ohio.

TIME DEFROST CONTROL

For use in defrosting systems requiring a fan delay or drain interval at the end of the defrost cycle, the 600 Series unit is designed for water spray, hot gas fan delay and electric heat fan delay defrosting. This control permits easy change of the frequency of defrost and the length of the defrost cycle in accordance with load characteristics.

Three separate adjustable settings are offered in the control: a pre-delay period or pump-down cycle, a defrost cycle, and a drain or fan delay cycle. The defrost cycle is adjustable from three to 45 min in three-min graduations.

Powered by a heavy-duty, four-watt, industrial-type motor, the control is offered in both 120- and 240-volt models, 60 cycle.

Paragon Electric Company, Two Rivers, Wisc.

MAGNETIC CONTROLS

Primary features of Model 58 across-the-line magnetic controls for constant speed motors are non-softening epoxy-resin encased coils; standard 60 cycle coils available for 110-120, 208-230, 440-480 and 550-560 volt; general purpose enclosure and solderless terminals. These starters and contactors for Nema sizes 0 and 1 for single and poly-phase operation are rated up to 7½ hp at 220 volt and 10 hp at 440 and 550 volt.

Arrow-Hart and Hegeman Electric Company, 103 Hawthorn St., Hartford 6, Conn.

MOTOR STARTING RELAY

Typical applications of this heavy-duty, current-type motor starting relay are on oil burners, submersible pumps and other stationary equipment having starting loads over 10 amp. For single-phase, ac appliances, the Klixon 6409 Series is rated for use up to 30 amp, 115 volt.

Constructed with a steel armature centered in a solenoid coil field, an all-welded relay has a bridging-type

HERMETIC COMPRESSORS

AND CONDENSING UNITS FOR ORIGINAL EQUIPMENT MANUFACTURERS

TO MEET YOUR SPECIFIC REQUIREMENTS

York offers original equipment manufacturers a prime source for hermetic compressors and condensing units. This equipment is expertly designed and precision built to serve your refrigeration and air conditioning needs.

DESIGNED FOR LONG, TROUBLE-FREE SERVICE

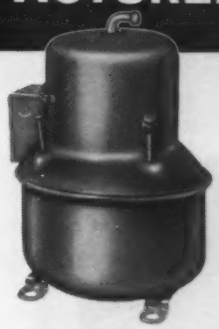
Compact, lightweight York Compressors are whisper-quiet, vibration-free. Motor is suction gas cooled for maximum performance, pistons have compression ring for highest efficiency.

BACKED BY 75 YEARS' EXPERIENCE

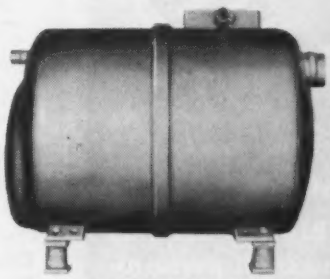
York has been a leader in the refrigeration compressor field since 1885. This 75 years' experience goes into every piece of York equipment you buy. Engineering advances from ultra-modern York and Borg-Warner Research Centers are built into each York Compressor to assure your absolute satisfaction.

CONTACT YORK BEFORE YOU SPECIFY

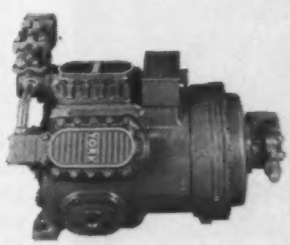
Before placing your next contract, it will pay you to contact York. If one of our wide choice of stock models isn't adaptable to your equipment, we can engineer a special model for you. For full details, write O.E.M. Sales Division, York Corporation, West Grantley Rd., York, Pa.



Vertical Models
⅓ HP to 3 HP



Horizontal Models
1½ HP to 8¾ HP



30 HP Hermetic Compressors

Note: Other models from 10 to 45 tons capacity for water cooling, air conditioning etc., also available.

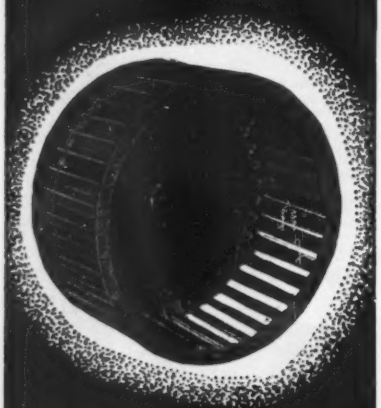
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uses
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because...
Revcor Blower Wheels meet the high performance and quality standards demanded by Westinghouse!

REVCOR SINGLE AND DOUBLE INLET BLASTAIRE BLOWER WHEELS ARE USED BY OVER 60% OF THE ROOM AIR CONDITIONER MANUFACTURERS!

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247 EDWARDS STREET
CARPENTERSVILLE, ILLINOIS

contact arm which is pushed into closed position by the armature movement. A phenolic case fully encloses the armature, switching element and contacts.

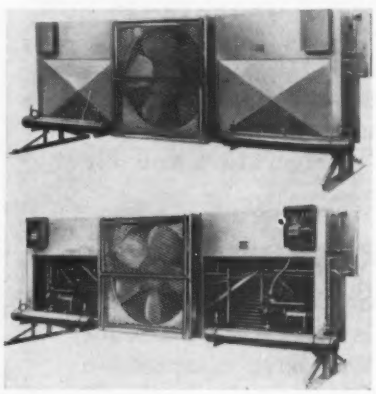
Silver-cadmium oxide contacts, which place two "breaks" and two "makes" in series, provide a life of up to 1,000,000 cycles at 5 amp, 230 volt or 10 amp, 115 volt.

Texas Instruments, Inc., Metals and Controls Div, 34 Forest St., Attleboro, Mass.

OUTDOOR COMPRESSOR

Fully protected from the weather, the Unicon Compressor, a complete air conditioning highside unit, can readily be installed on the roof, ground or any place where there is ample supply of air for cooling.

All standard servicing components, such as electrical controls, pressure



gauge valves, receiver inlet and outlet valves, purge valve and liquid sight glass, are accessible on the outside of the unit, so that it may be serviced without the necessity of opening the access panel.

Kramer-Trenton Company, Trenton, New Jersey.

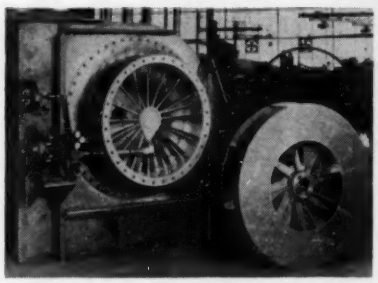
PUMP COMPOUND

Used to prevent stuck pumps over the winter shut-down period, Pump Aid is injected into the pump housing after pump is drained, providing a rust inhibitor which vaporizes and prevents oxidation by atmospheric change and controlled foaming action which prevents excess foam at start-up time. Flushing away once the pump is started, the compound preserves seals, will not freeze or evaporate and is water soluble.

Garman Company, St. Louis, Mo.

SOLVENT RECOVERY FAN

Basically an American Blower type HE fan with radial blade wheel, this gas-tight and spark-resistant fan for solvent recovery application was designed and built to minimize the possibility of an explosion when handling highly volatile vapors. Fabricated of aluminum, the 50-in. diam wheel (at the right in the cut) has a cast manganese-bronze spider. Variable inlet vane control is provided for automatic volume regulation. Shown at rear left in the cut is a bed plate with babbitted pillow block bearings provided



for mounting independent of fan housing on a concrete pedestal supplied by the user.

Rated at 200 bhp, this fan delivers 19,000 cfm at 1780 rpm, 100 F and 42.5-in. wg static pressure.

American Radiator and Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

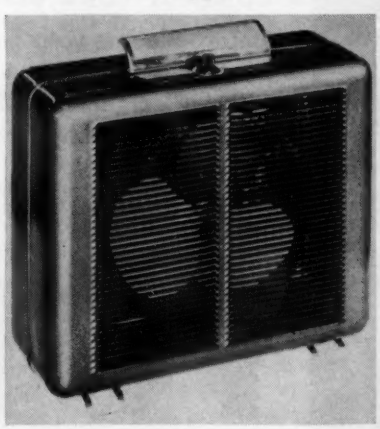
TIME SWITCH

Formerly rated at 35 amp, both Model 948 (Single Pole) and Model 954 (Double Pole) Torkmaster time switches are now UL approved at 40 amp. Available in the standard 24-hr dial, the units provide for setting the same on-off times each day. Any number of schedules, adjustable in 15-min intervals, may be scheduled on the one dial.

Tork Time Controls, Inc., Mount Vernon, N. Y.

PORTABLE ELECTRIC HEATER

Replacing the MHF series is the HDP 240-volt series, available in 3000, 4000 and 4800 watt models, all thermostatically controlled. Compactly designed, this heavy-duty portable features a hydraulic-type thermostat lo-



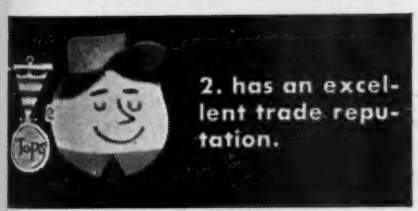
cated on top of the heater (see cut). A fan draws cool air in through the rear and over the heating elements to be propelled into the room. Located

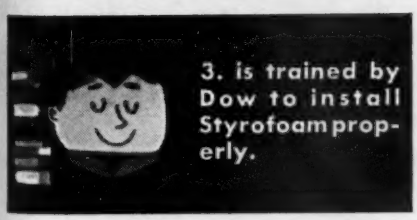


SIGN OF AN OUTSTANDING INSULATION CONTRACTOR

Look for this seal when you build cold storage facilities. It's displayed only by contracting firms with a record of top performance in space insulation. This seal means the contractor . . .







For the names of Approved Styrofoam Insulation Contractors in your area, write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. C.

STYROFOAM®

STYROFOAM is Dow's registered trademark for its expanded polystyrene

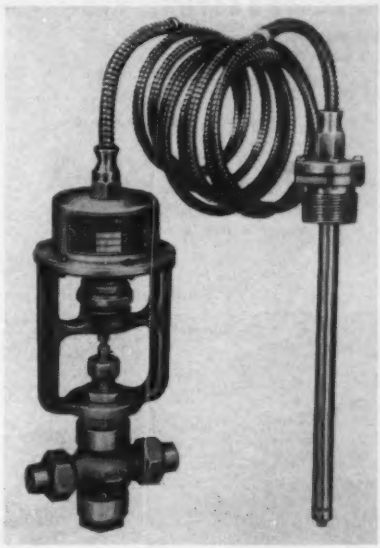
DOW

in the base is a positive pressure-type tip-over switch, automatically turning the heater off if it is upset.

Thermador Electrical Manufacturing Company, 5119 District Blvd., Los Angeles 22, Calif.

SINGLE-SEAT REGULATOR

Suitable for steam pressure up to 150 psi, this balanced single-seated temperature regulator is particularly rec-



ommended for applications requiring a self-contained dead-end shut-off regulator. The term "balanced single-seat" is derived from the fact that the line pressure on the main valve is balanced through a small pilot valve which, when opened, allows the main valve to be lifted from its seat.

Lawler Automatic Controls, Inc., Mount Vernon, N. Y.

DAMPER ACTUATORS

Providing a simple method of installing individual room temperature control on any new or existing air conditioning or warm air heating system, low-voltage, motorized Zone-A-Trol Damper Actuators are installed on the air supply ducts to each room or zone, and are controlled by individual thermostats. As the thermostat calls for heating or cooling, the damper is automatically opened until the set temperature is reached, and is then closed.

Actuators may be installed on any position, shape or size ductwork up to 22-in.; operating on low voltage, no BX cable is required.

Econo Products Company, Div of Viking Instruments, Inc., East Haddam, Conn.

FLOW COATING GLASS

Control of heat, fade and glare through reflection and absorption of the sun's rays by means of tinted glass in new constructions is rapidly growing. An alkyd-based formulation which permits flowing a transparent color coating directly onto window glass in position has been developed.

Method of application is cited as being fast and clean and not interrupting normal business operations, the coating bonding tightly to window glass and drying in 30 to 40 min. Available in eight colors, it may be washed in the standard manner without scratching, peeling or chipping.

American Glass Tinting Corporation, Houston, Tex.

TEMPERATURE ALARM

Simultaneously monitoring up to 100 temperature points, depending upon the number of 10-unit panels it contains, the Simultaneous Temperature Alarm Readout (or S-T-A-R) is so designed that when any one of the temperature points being sensed reaches the temperature indicated on its control dial, an alarm is sounded and the critical point identified by a numbered light on the control panel.

As each channel operates independently, the unit will continue to sense the temperature points after one has been off-normal and the audible alarm sounded and turned off. The alarm may be turned off by a reset push button, while the identifying light remains on as long as the temperature is off-normal.

Fischer and Porter Company, 303 Jacksonville Rd., Hatboro, Pa.

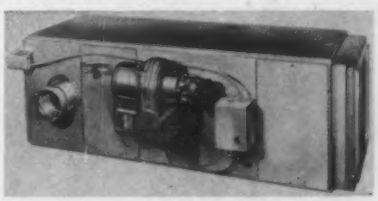
SHOCK SUPPRESSOR

Control for water shock in pipe lines is offered by an instrument utilizing a freely moving piston working against a cushion of compressed air within a cylinder. Any shock which develops from the sudden closing of a faucet or valve in a pipe line is transmitted to the piston and, in turn, to the air cushion.

American Tube Products, Inc., West Warwick, R. I.

HORIZONTAL FURNACES

Two models, only one of which is shown, have been added to this manufacturer's line of horizontal heating equipment. New in the line are gas-



and oil-fired models providing a high degree of flexibility.

Gas-fired units are available in 80,000, 100,000 and 135,000 Btu/hr

See The Newest Equipment at the

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HEATING & AIR-CONDITIONING EXPOSITION

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Memorial Auditorium



IF you're an engineer . . . architect . . . contractor . . . dealer . . . distributor . . . in building management or operation . . . you'll find that a visit to this fact-filled exposition will bring you up-to-date on the latest developments that have been—and will be—affecting your everyday business.

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MEET more than 1000 technical representatives of the leading manufacturers in your industry.

DISCUSS with them how their new products can lead to bigger profits for you.

COMPARE and judge at first-hand the relative merits of competitive products.

DECIDE which of them can best suit your needs.

2209

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input. There are three types of blower motors: shaded-pole, split-phase and permanent split capacitor. Diverter and burners may be placed in the front or rear of the furnace.

Available in 84,000, 112,000 and 135,000 Btu/hr input, oil-fired furnaces come with the same choice of blower motors as gas-fired models. Rotation of the furnace end over end, turning the burner upright and relocation of the blower and fan-limit control offer easy alteration of the air discharge direction.

Armstrong Furnace Company, Div of National Union Electric Corporation, 851 W. 3rd Ave., Columbus 12, Ohio.

2-IN-ONE VALVE

Besides replacing the costlier assembly of two conventional butterfly valves and a flanged "T" connection, the Triangle Valve is cited as being easier to install and maintain. Shaft packing may be removed from either end of the through shaft, inspected, replaced or adjusted without removing the valve. Constructed of corrosion-resistant materials, the valve gives flow control in cooling water systems and in other applications where two streams flow to or from a single pipe.

U. S. Valve and Engineering Company, P. O. Box 14015, Houston, Tex.

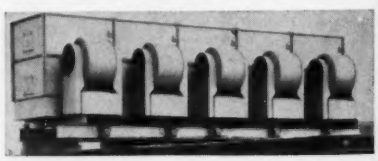
THREE-PART HEAT PUMP

Adaptability of the Tri-Pak to building types stems from its three-part design: a remote condenser for outside installation and separate indoor coil and air handler which can be placed under the eaves, in a utility closet or outside in the breezeway. Capacity is large enough for small commercial installations as well as homes, Model 30HS providing a cooling capacity of 37,000 Btu and a heating capacity of 38,800 Btu. Accessory heating capacity of 12 kw is available for the coldest day, boosting total heat output to 79,800 Btu.

Perfection Industries, Div of Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

WATER COOLING TOWERS

Principal features of the 4-B series towers are quiet operation, gained through use of squirrel cage blowers



rather than propeller fans, and low silhouette. Sixteen sizes are available in the line, with capacities ranging from five to 360 ton. Maximum heights are from 5 ft 5 in. through 7 ft 8 in.

Simplify Air Conditioning Control Panels with

RANCO "G" CONTROLS

Compact, Ranco "G" Controls were developed for air conditioning control panel designs to take less space, are easy to install and are readily adaptable to your specific product.

Ranco "G" Controls include both high and low pressure models with automatic or manual reset; low pressure cycling controls with (for factory use only) or without differential adjustment; and dual pressure controls by pairing combinations of single controls. Three different switch assemblies provide ratings from pilot duty, intermediate to high ampere switching capacity in single pole, single or double throw action.

For further details call or write to Ranco Inc., 601 West Fifth Ave., Columbus 1, Ohio.

Ranco®
INCORPORATED
COLUMBUS 1, OHIO

World's Largest Manufacturer of Refrigeration Controls

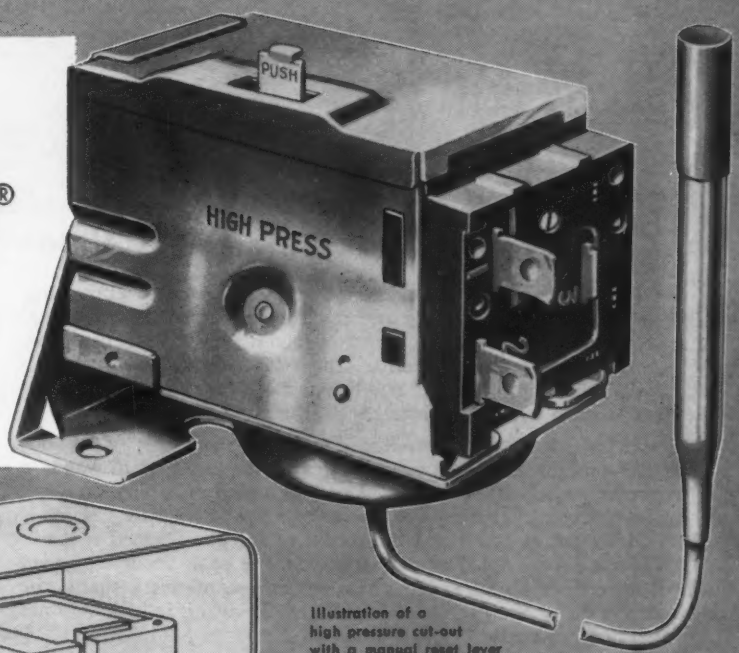
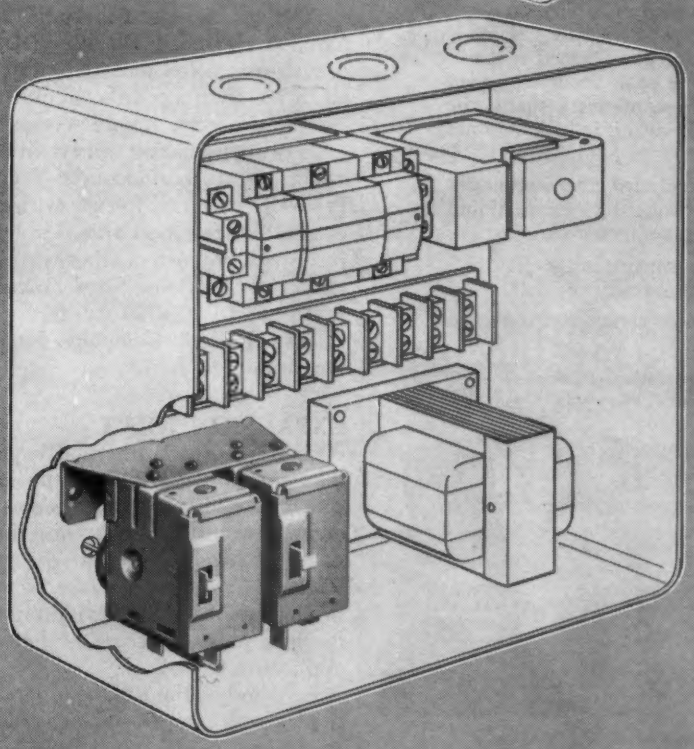
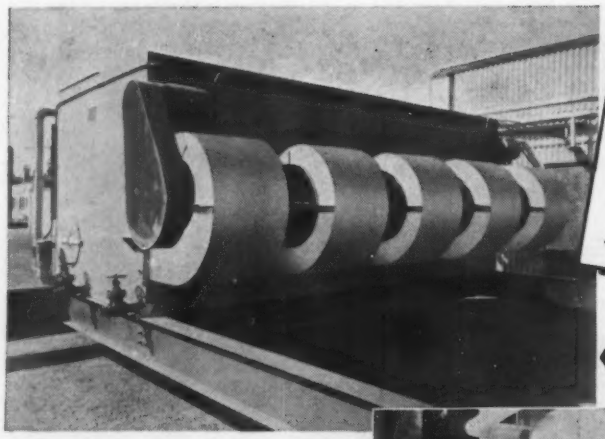


Illustration of a high pressure cut-out with a manual reset lever



- Automatic or manual reset.
- Switch assemblies for electrical ratings from pilot duty through 18 amperes, full load.
- 7 to 425 psi selective ranges, non-adjustable in the field.
- Screw or quick-connect terminals.

Panel installation of dual pressure with high and low pressure Ranco "G" Controls mounted on a common, single bracket and connected electrically by a jumper. Also, each can be individually mounted on separate brackets, according to panel space.

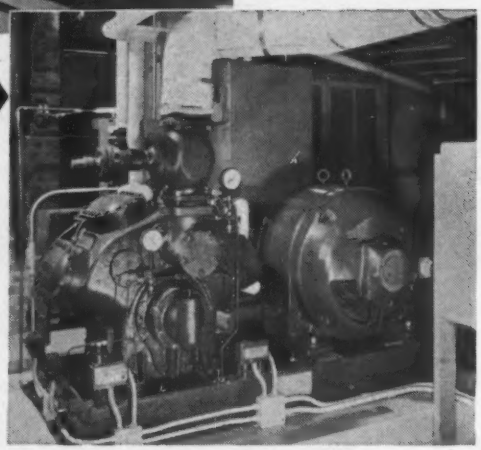


Vilter Report Card

Grade	Service Record
A	Efficient, alternating zone-load operation.
A	Exceptionally low operational cost.
A	Uninterrupted air conditioning service.
A	Smooth operation with minimum maintenance.

View of the Vilter VXF evaporative condenser located on the roof just outside the compressor room.

View of one of the two Vilter 8-cylinder VMC Freon compressors with a 100 h.p., 1175 r.p.m., part winding motor drive. These compressors are located on an upper floor, above an office.



Cool Thinking ... Cool Fun in Marquette University's

Air Conditioned Brooks Memorial Union

Brooks Memorial Union is the hub of many Marquette University activities—professional meetings and conferences attracting a national audience, exciting school dances, excellent food facilities in the cafeteria, snack bar and private dining rooms. One key to its year-'round popularity and usefulness is the air conditioned comfort provided by the Vilter installation on this Milwaukee Campus.

To provide adequate air conditioning on a conservative appropriation and to minimize yearly operating expenses, the system was laid out to provide alternating zone-load cooling based on a "traffic flow" and usage pattern. During normal occupancy the entire Union is cooled. However, at peak loads only part of the conditioned space in Brooks Memorial is cooled at one time. As the peak occupancy load shifts from cafeteria and grill to the ballroom-conference room, the air conditioning is also shifted. Results of operating in this manner have been highly satisfactory.

Vilter equipment furnished on this job included two 8-cylinder VMC compressors; VXF Freon evaporative condenser; Freon liquid receiver; heat exchanger, cooling coils, motors, and controls.

"Very satisfactory performance with only routine maintenance," is the praiseworthy comment by Marquette University officials.

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Write for these helpful bulletins to: The Vilter Manufacturing Company Dept. AR-804, 2217 S. First Street, Milwaukee 7, Wisconsin



Bulletin 631 Vilter Uni-Chiller



Bulletin 820 Vilter VMC Freon Compressors



Bulletin 732 VXF—VSC Evaporative Condensers

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REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

exclusive of foundation beams. Water-temp tower shown features pull-out design of decking for easy cleaning.

Larger towers are constructed with separate cells used as a unit but individually equipped with blowers and drives. Independent operation of any number of cells is possible.

Also available are filtered air inlets in standard sizes for towers used in high contaminated atmospheres and evaporative-type towers substituting an open evaporative heat exchange coil for the decking.

Binks Manufacturing Company, 3114 Carroll Ave., Chicago 12, Ill.

PITCH PULLEYS

Highly flexible variable speed drives with ratios up to 4:1, in the range of ⅛ to 2 hp and using a combination of two variable pitch pulleys are now available. Connected by either "A" or "B" belts, one pulley is spring-loaded, the other manually actuated.

Turning a hand wheel to control the operation of the drive on the manually-operated pulley widens or narrows the belt-seating groove. Manual actuation of this unit produces an instant inverse change in the pitch diameter of the spring-load pulley. Both are offered in a size range of 3½, 4, 5 and 6-in. OD and are available in combination or individually.

Maurey Manufacturing Corporation, 2907 S. Wabash Ave., Chicago 16, Ill.

TERMINAL BOXES

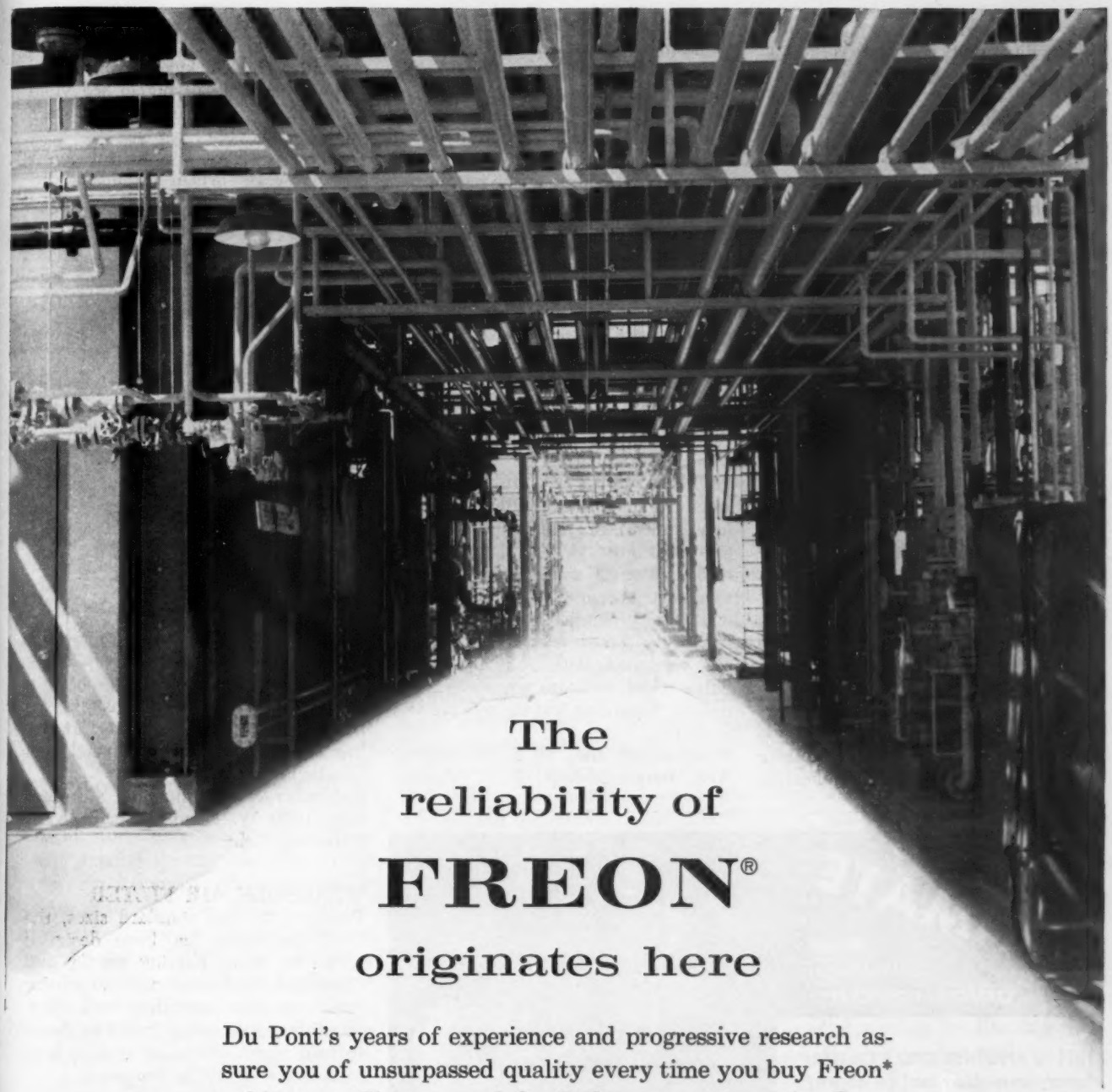
Built of cast iron or sheet metal, with neoprene gasketed covers, various models and sizes of waterproof multi-junction thermocouple terminal boxes provide protected termination of from six to 100 thermocouple circuits, wherever dusty, oily, humid, corrosive or other contaminating environments might affect thermocouple accuracy. Primarily designed for use with multi-conductor thermocouple cable, the boxes will find use in other wire termination applications. Sizes range from 8 x 8 x 4 to 30 x 24 x 8 in.

Thermo Electric Company, Inc., Saddle Brook, N. J.

EXPANSION JOINT

Permitting greater thermal expansion than previously available, the Hydro-Tite, a leakproof expansion joint, eliminates leaks, breaks and failures due to expansion and contraction strain. It relieves pressure from piping and joints, having widespread use for low pressure steam or hot water applications.

Installed in the fully extended position it will compensate for expansion up to two in. in the ¾-in. diam size and up to 2¾ in. in the 2-in. diam



The reliability of FREON® originates here

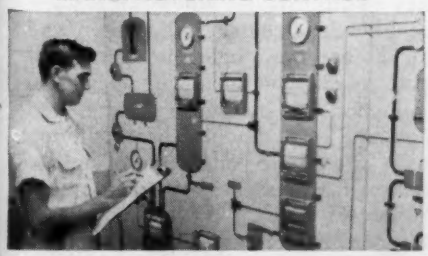
Du Pont's years of experience and progressive research assure you of unsurpassed quality every time you buy Freon* refrigerants. Factory-sealed cylinders guarantee purity. Specify Du Pont "Freon" for your air conditioning and refrigeration designs to be *sure* of dependable product performance.

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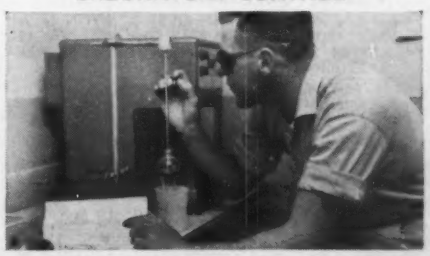
BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, Wilmington 98, Delaware

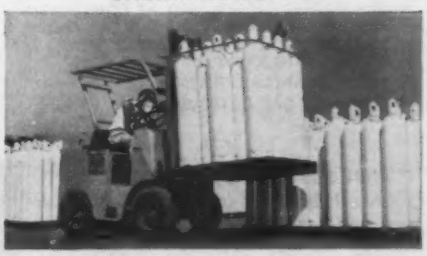
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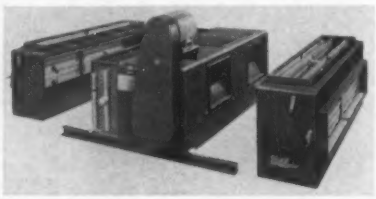


**Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.*

size. Two series are manufactured, one with sweat connections at the ends, the other a threaded series FPT x FPT (IPS). It may be installed where pressure does not exceed 100 psi and where temperature does not exceed 240 F.
Slant/Fin Radiator Corporation, 130-15 89th Rd., Richmond Hill 18, N. Y.

BLOWER-TYPE CONDENSER

Combining refrigerant condensing with heating and ventilating, the Air-



con utilizes rejected condenser heat for these applications. Seven models of this blower-type air-cooled condensing unit are available in eight different unit arrangements with capacities from 10 to 50 ton. Shown in the cut are, from left to right, mixing box, basic unit and discharge box.
McQuay, Inc., Minneapolis, Minn.

INDICATING RELIEF VALVE

Compact size, variable relief pressure adjustment and continued indication of operation even after pressure has returned to normal make the "Demi Tattle-Tale" valve highly suitable for applications where it is important to know if pressure has opened the valve even momentarily. Featured is an easily visible red anodized pin which pops out of the body at the instant the valve opens, remaining in the out position until manually reset.

Equipped with a pressure adjustment screw on the top of the bonnet, the valve can be furnished for relief settings from three to 100 psi, and can be used in conjunction with microswitches for additional signalling methods.
George W. Dahl Company, Inc., Bristol, R. I.

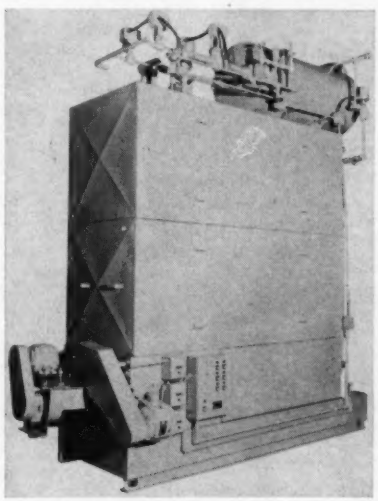
COMBUSTION INDICATORS

Intended to take over the job of furnace supervision, Hazegage Combustion Indicators are graduated for direct reading of smoke and haze, assuring continuous information for maintaining combustion at maximum efficiency. Panel instrument gauges are equipped with red and green lights which indicate adjustments required. Recording instruments are also available.
Photomation, Inc., 96 S. Washington Ave., Bergenfield, N. J.

ICE MAKER

Available in 15, 30, 45 and 60-ton capacities, the Krackice Maker is cited as being capable of higher ice yield per cu ft of space occupied than were previous models.

Conveyor is of the helical screw type integrally-driven through shaft-



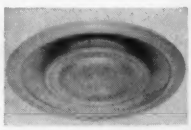
mounted gear reducer and vari-pitch v-belt motor drive with adjustable base. A uni-mount water circulating pump is fully piped and installed as part of the unit, with water sprays, headers and piping of galvanized steel installed complete.
Kohlenberger Engineering Corporation, 1600 W. Commonwealth Ave., Fullerton, Calif.

WASHABLE AIR FILTER

Produced in four standard sizes, the DusT-ban Filter has been designed with the same filtering media and electrostatic action as more expensive units in this manufacturer's line. Never requiring oiling, it can be rinsed in cold water when the surface load indicates cleaning is necessary.
Skuttle Manufacturing Company, Milford, Mich.

FIXED PATTERN DIFFUSER

For use when no adjustment of air discharge is necessary is the Kno-Draft DF fixed pattern overhead air diffuser. Key features of the unit shown include a built-in damper, urethane foam plastics rim gasket for positive



seal between ceiling and diffuser, and air discharge in single, circumferential pattern cited as achieving maximum induction to minimize drafts and equalize room temperature. Alternatives offered are connection of unit to duct collar or securing it to structural supports.
Connor Engineering Corporation, Danbury, Conn.

THE ULTIMATE IN THE COMPRESSION REFRIGERATION CYCLE*



THIS IS ANOTHER CYCLE CENTER, factory assembled and on its way to a 150 ton poultry freezing plant.

What will it do?*

It will provide liquid overfeed to the evaporators, catch the excess liquid and recirculate it to the evaporators, with these results:

- FULL COMPRESSOR PROTECTION AGAINST SLUGS
- PEAK COIL AND COMPRESSOR EFFICIENCIES
- SUB COOLED LIQUID FEED AT CONSTANT PRESSURE THE YEAR AROUND
- PRACTICALLY UNLIMITED RATE OF LIQUID FEED AT ABSOLUTELY NO POWER COST
- NO MECHANICAL PUMPS
- NO FLASH GAS IN LIQUID LINES
- SAFE, AUTOMATIC PLANT OPERATION
- OIL SEPARATION, ANY REFRIGERANT
- HIGHER SUCTION PRESSURES
- LARGE POWER SAVINGS
- LARGE SAVINGS IN FIRST COST ON NEW PLANTS. FOR EXAMPLE, THE RECEIVER IS NOT REQUIRED AND SURGE DRUMS ARE ELIMINATED.
- AUTOMATIC HOT GAS DEFROSTING AT MINIMUM COST

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ASHRAE JOURNAL
DECEMBER 1959

Improved zoning

betters department store air conditioning



A. I. McFARLAN
Member
ASHRAE

Designer of the air conditioning installation for the Sibley Department Store in Rochester, the author discusses how to improve antiquated and inefficient zoning by the use of the Closed and Staged Cycle which was used at Sibley's and includes one system for heating and cooling. Also discussed are the staging of compressors for reduction of hp in air conditioning systems, the Closed Cycle heat pump to transfer heat within a project and volumatic control.

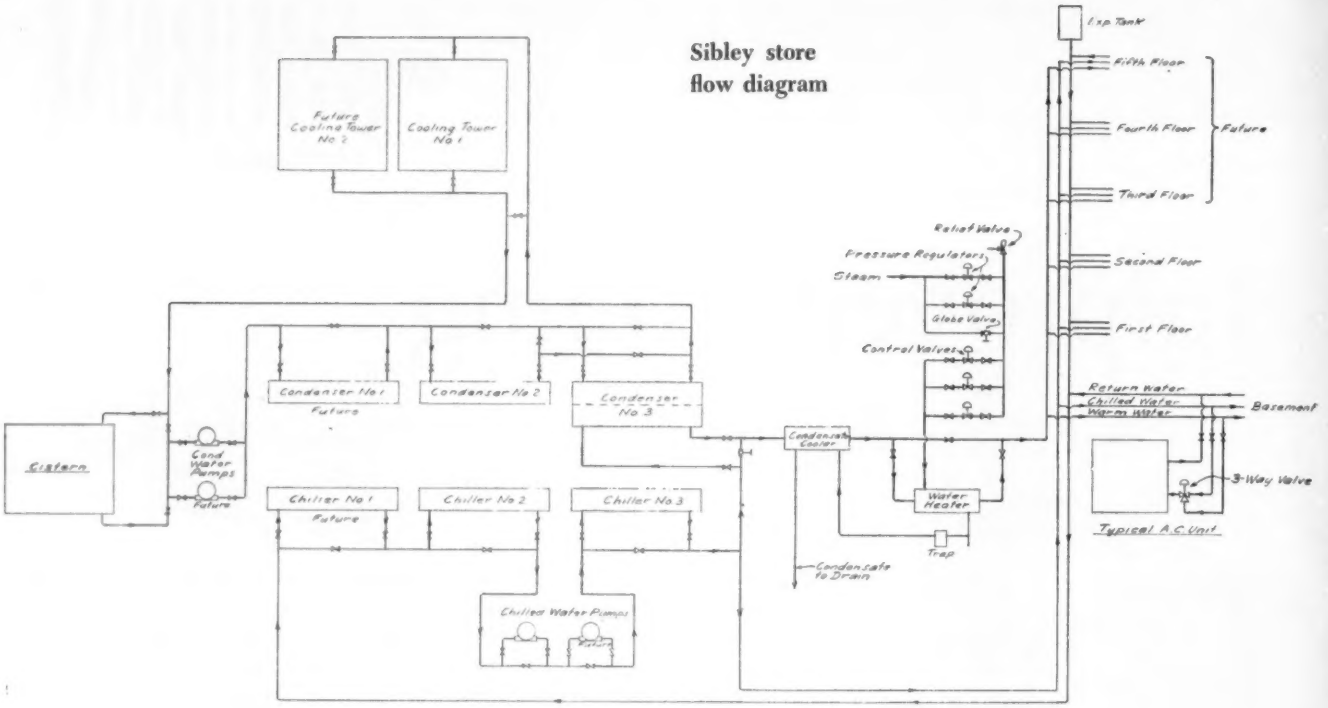
An improvement which should receive more consideration in department store air conditioning is zoning. Part of the complication in the air conditioning of large office buildings can be traced to the peripheral system. Costs involving double fans, elaborate dampers, and in many cases long, high-pressure duct systems are chargeable to cooling the interior area while the exterior is being heated. But peripheral office building zoning can be greatly improved, with savings in building and air conditioning equipment.

Department stores are zoned on the basis of overall floors, or combination of floors, frequently without regard to interior and exterior spaces or simultaneous heating and cooling requirements. Drawings for a proposed department store displayed an air conditioning unit to be located in each of four corners of three floors; one floor largely below ground, a ground floor, and the top floor under a roof. A large part of the air from each unit was delivered to interior areas, but the drawings showed air leaving the main coil at the same temperature for interior and exterior areas. In some cases, this air went to fitting rooms around the exterior, and in other cases to offices, both of which must be heated while interior sales areas must simultaneously be cooled. There were reheat coils in the branches from the main airstream to the fitting rooms and offices, which meant that during the heating season air was cooled to a temperature which would satisfy the interior sales space, and then part of the air bled off to heat the chilled air through reheat coils in order to heat the exterior offices and fitting rooms. The heated air had to be recooled before being reheated as it went through its cycle.

Two other stores recently occupied branches with three story buildings, each having a basement, ground floor, and second floor under a roof. Two large double fan systems supply air to half of each floor, completely disregarding different zone requirements on the three floors. During the heating season, air with varying proportions of outside air, in addition to the ventilation requirements, is provided at a temperature low enough, when it is available, to satisfy the basement which requires cool air the year around. The air from the same fans and coils is furnished to the ground floor after having been cooled to satisfy the basement, then reheated to satisfy the ground floor. The air to the top floor is likewise first reduced in temperature, and then must be reheated even more, since this floor is under a cold roof. All of this unnecessarily added reheat is nullified with more excess cold outside air, then reheated again on the next cycle. Thus, double fans and building space to house unnecessary equipment produced costly and inefficient results, where an efficient system would have cost only a little more.

Department stores with large interior areas require cooling the year around. In many cases with high intensity lighting and heavy population areas, the internal load is substantially higher than for the

A. I. McFarlan is President of A. I. McFarlan Co. This paper was presented as "Proposed Cure for Infectious Repetitis in Department Store Air Conditioning" at a meeting of the ASHRAE Rochester Chapter, September 9, 1959.



Sibley store flow diagram

less populated summer condition. During the heating season department stores desire a temperature between 70 and 75 F, where under peak conditions in the summer, when the outside temperature is 95 F or higher, 78 to 80 F inside is generally acceptable. This means that air must be supplied to internal areas during the heating season at a lower temperature than will be required during the cooling season. Increased populations and increased lighting increase the required temperature difference between the supply air and room temperature during the heating season in such installations.

If most air conditioning engineers were questioned as to the least expensive method of cooling interior areas in the winter season, they would recommend outside air to the extent necessary above the ventilation rate to satisfy the inside temperature. This answer has resulted in a number of problems which are questionably solved by using double fans, generally triple dampers, spill air shafts, and a multiplicity of damper controls. These double fans and dampers take a lot of space which is always valuable in a department store. In addition, as pointed out above, this solution is inadequate for the several warm days which occur in northern areas, and for the many warm days which occur in those southern areas where freezing temperatures require shutting down the cooling tower during a large part of the year. Of course, the cooling tower can be winterized, but this also adds complications, and at present winterizing is more often omitted than supplied. This is one of the overlooked inefficiencies in the air conditioning business. It is a fact that outside air beyond that required for normal ventilation when used for cooling is warmed by the internal heat from lights, people, etc., and then removed with space consuming multiple fans and dampers. Simultaneously, heat is being generated to heat the exterior and the area in the vicinity of entrance doors of the department store.

Still another inefficiency results in department stores where large quantities of outside air are used for cooling. On mild days there is frequently greater wind velocity and consequently the greatest dust concentration in the air. Filters must handle four to five times the normal amount of outside air with this increased dirt. This results in the store's cleaning bills being much greater during this period and merchandise is subjected to unnecessary quantities of dust and dirt. Dirty filters throttle air flow and reduce capacity. When the filters get dirty faster than they can be cleaned capacity also suffers.

ENGINEERING STUDY

The Sibley, Lindsay and Curr Department Store with an area of 400,000 sq ft solved some of these problems. The floors were zoned so that the interior was on one system and the periphery on another. If this were not done the result would be almost an impossible problem. For instance, during the heating season the more cooling furnished to satisfy the interior of the store, the more the exterior would be reduced in temperature from a level already too low. Vice versa, if the controlling thermostats were located near the entrances then the interior would be overheated.

Second, Sibley is using the closed cycle, which provides cooling any time of the year whenever required by a thermostat, while the condenser heat, dissipated by water at approximately 95 F, is used to heat the exterior and areas around the doors. The closed cycle is a heat pump application applied to transfer heat within the building rather than dissipating it outside the building as most heat pumps are designed to do. When more heat is generated in the interior

than is required for the exterior, the cooling tower can be operated on a winter cycle. No heat from the duct system is provided directly to the vestibules or areas immediately in front of vestibule doors, but spread over the entire periphery. Concentrated high temperature heat is always necessary around vestibules to overcome the inrush of cold air. The relatively low temperature heat from the condenser is not offered as a solution to this problem.

There are two circuits in one of the two 300 hp centrifugal compression unit condensers. One circuit operates on the cooling tower similar to ordinary systems. The second circuit is tied into the discharge of the chilled water pump so that a single pump can pump water through a water cooler to be cooled, or through the second condenser circuit to be heated.

The water from the water cooler passes through one pipe to one inlet side of a three-way valve ahead of each air coil, and the warm water from the second condenser circuit passes through a second pipe to the other inlet side of the three-way valve. The coils are of the wide range type, that is, so designed that the water leaving the coil approaches the entering air temperature much more closely than usual. In this way, the water can be returned through a common line since it will have substantially the same temperature whether it has entered the coil for heating or for cooling. The water returns to the pump and separates into the two circuits, depending upon how much water is being passed at any instant by the total number of three-way valves. These three-way valves are always passing the same amount of water which may be either warm condensing water or chilled water from the water cooler.

The two circuits at different temperatures are mixed the year around for temperature and humidity control. Where supplementary heat is required in addition to that furnished by the heat pump cycle, the object is to provide a means so that the supplementary heat introduced is limited to that instantaneously required.

If the closed cycle is not used, and if the necessary precautions are omitted, then mixing is unwise and separate heating and cooling valves must be provided, so arranged that warm and cold water can never be passed to the same coil simultaneously. The closed cycle, as the name implies, is a completely closed circuit and a heat pump operation so that a heat balance will show that only sufficient power is required to separate the two temperature levels. For maximum efficiency, it is desirable to maintain the warm water as low as possible and the cold water as high as possible to satisfy the instantaneous load. To accomplish this a control means is used which involves a thermostat in each zone and a humidistat in one or more areas, at least where the highest humidity would normally occur. The humidistat controls the supply water temperature which in turn provides a means of removing more moisture and consequently drops the leaving dewpoint from the coil as low as necessary to satisfy the humidity, but maintains the chilled water supply at the highest possible temperature which results in maximum economy. If the humidity is satisfied in each zone, then the water leaving the last stage water cooler is raised until one or more zone thermostats or humidistats are no longer satisfied, then the water temperature is dropped.

If the dewpoint leaving the air cooling coils is controlled as well as zone temperature then humidity is likewise controlled. Several methods are possible to simultaneously control temperature and humidity. One method is to let the humidistat regulate the mixing to satisfy the dewpoint in each zone, with the worst zone correcting the supply water temperature. This method, which is the volumatic control, is used in the Sibley basement cafeteria which is subject to highly variable loads. The variable temperature is regulated by thermostats which control air volume by an improved technique. Another method is to regulate face and bypass dampers under humidistat control and to regulate zone temperature by mixing water temperatures.

An improvement which should receive more attention in department store air conditioning is zoning.

Here, a constant quantity of outside air is used the year around.

Automatic transfer of heat anywhere within the building.

ADOPTED SOLUTION

A constant quantity of outside air is used the year around. This amount is determined by the ventilation requirements which are a function of the operating conditions and reasonably constant the year around.

By using a constant quantity of outside air, the filter inspection program is solved and the necessity of short interval filter changes required is eliminated when increased quantities of outside air are used.

Since the closed cycle has been in operation, there has been a marked reduction in steam requirements for heating. This can be checked readily and involves only the computation of the heat generated from the lights, people, etc., added to the heat generated from the heating source, computed from the fuel consumption with reasonable deductions for the domestic hot water requirements. If one then computes the theoretical heat load from the conduction losses and outside air requirements, generally he will find a sizable unbalance showing far more heat generated than is required.

This can mean but one thing. In most department stores using outside air for cooling, heat is being generated in the periphery, and then part of this heat is removed by the increased outside air, in addition to removing only the internal load. As an explanation of what happens, it is altogether possible that heat generated in the periphery rises to the ceiling and then the air motion carries it to the return duct where air is being exhausted by the spill air fan. In turn the cool air supplied to the interior falls to the floor and travels to the exterior area where heat is desired. This in turn requires a further excess of heat to satisfy the area between eye level and the floor. The closed cycle prevents this. The system automatically

strikes a heat balance, since the excess heat from the interior is returned to the exterior.

Air conditioning was installed without the loss of sales space and in many cases the equipment was located in present ventilating rooms and above entrance lobbies. This space savings is largely due to the fact that double fans, multiple dampers, spill air shafts, and exhaust ducts are not required with the closed cycle.

Multi-zone units require more space than single zone units. Where units can be confined to a single zone, the multi-zone units need not be used. Keep in mind that interior and exterior zones are separated at all times. Cafeterias, the grocery department, etc., with special requirements, have their own systems.

THE STAGED CYCLE

This cycle takes advantage of the principle of staging compressors by passing the water through water coolers in series. If the customary 10 F drop through the water cooler were used, there would be but little gain. Staging is used in combination with the wide-range air cooling coil, where upwards from 24 F rise in water temperature is possible. The compressor horsepower using 25 per cent outside air can be reduced to approximately ¾ hp per ton. In areas where 100 per cent outside air is used, such as restaurants, the compressor horsepower can be reduced to about 6/10 hp per ton. In addition to the reduction in hp, the capacities of the compressors, especially the first and second stages, are substantially increased by reducing compression ratios and improving volumetric efficiency.

The coils for the Sibley store consist of a combination of 14 fins per in. tubes to remove sensible heat and 8 fins per in. to remove latent heat.

ADAPTABILITY

For different population loads and for different outside conditions, the ratio of cooling load and moisture removal load varies considerably. It is customary in ordinary systems to pre-determine the water temperature calculated sufficiently low to satisfy the worst condition which may only occur a few hours a year. With the staged cycle taking advantage of efficiencies possible when higher temperatures can be used, the water temperature is constantly reset as high as possible to satisfy the humidity requirements. This has a number of advantages besides reducing compressor hp and increasing compressor capacities. For instance, the right dewpoint air is always being supplied to satisfy the store conditions. Since these requirements are always changing, the system is changing in accordance with the requirements. Many systems today supply air unnecessarily low for a large part of the year, and due to a fixed water temperature, fail to handle the moisture removal on high wet-bulb days with heavy population, when a lower water temperature would produce a more satisfactory condition. The mixing of two temperatures of water, possible with the closed cycle, solves problems in a better way than possible with single stage compressors and a single water temperature. Raising the water temperature on the staged cycle is possible with wide-range coils.

A non-overloading feature is a decided asset in automatic starting and stopping, especially on high wet bulb days, when the water from the cooling tower is at a peak. While the new hermetic centrifugals have another means to prevent overloading, this is accomplished by reducing capacity at the time the greatest capacity is needed most. The staged cycle, on the contrary, increases capacity as the water temperature rises, and limits the necessity of the capacity throttling device since the motor will have much less chance to overload. This is especially important on the pull-down when above normal capacities are possible.

In those instances where if the overloading feature of the single stage centrifugal compressor throttles capacity, due to inability of the water cooler and condenser to transfer the increased heat the compressor can handle at reduced compression ratios, then the pull-down period will naturally be much longer and require more power.

At the Sibley store the entire system sequences in starting from pushbutton control, then the compressors are started and stopped automatically to satisfy exact load conditions. This results in a substantial savings in labor costs and simplification of control. Combined with automatic temperature and humidity control by means of the closed cycle, automation in general is greatly improved.

IN THE FUTURE

While water is used at Sibley's the staged cycle and closed cycle can provide a summer cooling and winter heating system introducing a glycol or other anti-freeze air source heat pump which will:

1. Remove heat when necessary any time of the year.
2. Automatically transfer heat anywhere within a building including the excess heat from sun effects on one side to another area requiring heat.
3. Remove automatically excess heat whenever necessary. Removal will be only that which cannot be utilized by transfer.
4. Automatically remove heat from outside air at any temperature even as low as −10 F to warm up a building or provide heat in excess of that internally generated and transferred where needed.

NEXT MONTH——

Preview of ASHRAE semiannual meeting in Dallas, Texas, February 1-4. Final program. Abstracts of technical session and conference papers. Floor plan and list of exhibitors for 2nd Southwest Heating and Air Conditioning Exposition.

Some solutions to

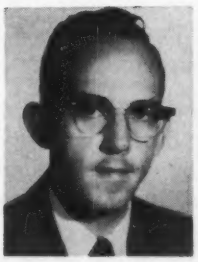
Steel plant ventilation problems

"Ventilation history" has its place in the steel industry and for other industries that use large, high-bay buildings.

In the beginning, "gravity ventilation" was the only means provided for environmental cooling and contaminant control. Some of the buildings had a volume of several million cubic feet of air. It soon became obvious to some ventilation engineers that attempts to ventilate entire structures were folly; a different approach was necessary to provide adequate control.

At about the same time, the steel industry began its phenomenal growth and, approximately 35 years ago, gave recognition to problems of employee well-being which we today recognize as the science of industrial hygiene. It was this recognition, and the corrective measures instituted, that caused the initial concern over good ventilation practices.

The buildings were more tightly enclosed to protect product and employees, and it became necessary to exhaust processes which emitted environmental air contaminants. As we all know, when we remove air from a closed chamber, the chamber will eventually collapse. This did not happen to the steel industry, but I sometimes wonder why not when I recall the tremendous volumes of air that were exhausted from some buildings with no provision for as much as one cubic foot of make-up air. Instead, the buildings leaked air in from any crack, doorway, window



F. E. TUCKER

or roof monitor that they could find; and during cold weather, employees located around the perimeters of buildings were exposed to cold drafts.

This condition brought about the installation of salamanders and eventually unit heaters for spot heating, and with them came new industrial hygiene problems.

There follows a citation of some of the area heating and ventilating systems that were installed at Weirton to overcome these problems. The first of these systems was installed during the Second World War in a building that was then a shell plant and today serves as a company warehouse. This same system is in use some 17 years later with the same original fan, ductwork, and heating coils.

In designing it, our Engineering Department had several objectives in mind: (1) Design a system that would eliminate the multiple maintenance problems encountered in the use of unit heater ventilators; (2) Supply the maximum amount of conditioned fresh air (not less than 2 cfm per sq ft of floor area) without unduly increasing the cost of heating the air; (3) Provide an efficient method of thermostatic control to maintain constant uniform room temperatures and eliminate manual control of the system; and (4) Provide efficient air distribution at an elevation above the floor capable of producing maximum value per cubic foot of conditioned air.

An accompanying illustration (Fig. 1) shows a side elevation view of the system presently in use at Weirton. This is equipped with dual dampered air intakes of equal size, one intake admitting fresh outside air and the other provided for recirculation of room air. The dampers are so designed to admit a uniform amount of air to the plenum, regardless of the relative amounts of fresh and recirculated air.

The position of the dampers is controlled by a thermostat located in the air plenum. When the outside air temperature entering the plenum drops below 32 F, the thermostat actuates a motorized drive unit and progressively closes the outside air damper and opens the recirculating air damper so as to admit sufficient recirculated air to maintain a mixed air temperature of about 32 F in the plenum. When the air entering the plenum is above 32 F, the outside air dampers remain open and the recirculating air dampers closed, thus admitting 100 per cent outside air to the area under ventilation. Outside air temperature must drop to −10 F to cause 50 per cent recirculation.

The amount of steam supplied to the radiator is controlled by a second thermostat located in the area to be heated and is responsive to the temperature in this area. In most operations this thermostat is set at 70-72 F. If room temperature rises above this predetermined temperature, an electrically operated governor valve restricts the

F. E. Tucker is Industrial Hygienist with the Weirton Steel Company. This is a condensed version of "General Ventilation in the Steel Industry" as presented at the Industrial Ventilation Conference, ASHRAE annual meeting, Lake Placid, N. Y., June 22-24, 1959. The full text will appear in a Symposium Bulletin covering all papers presented at this Conference.

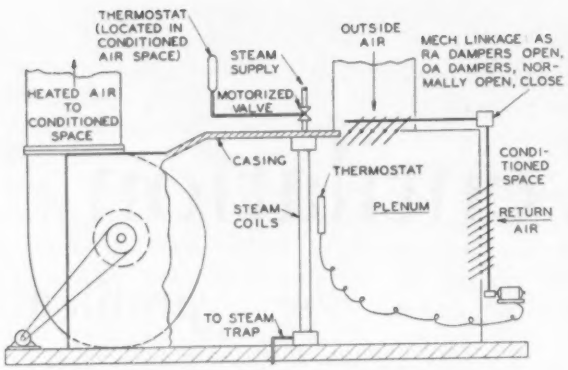


Fig. 1 Ventilation unit used at Weirton. Note dual-dampered air intakes, thermostatically controlled components and provisions for flexible operation



Fig. 2 Discharge outlets for building contains high-speed annealing line. Crane operates without interference

flow of steam to the radiators; and if the room temperature drops below 70 F, the valve progressively opens to increase the flow of steam. The radiators are so designed that when the air in the plenum has a temperature equal to 32 F, which is the temperature at which the recirculating damper begins to open, the radiator operates at maximum capacity to maintain a discharge air temperature of 120 F at the fan outlet.

So far we have achieved three of the four objectives previously listed. We have designed one single air conditioning system to replace numerous small unit systems. We now have maintenance on one fan, one fan motor, and one set of steam coils, whereas a comparable system designed on a unit basis would have required from 10 to 20 such individual maintenance problems. It is no more of a problem to maintain one 200,000 cfm control system than it is to maintain one capable of producing only 15,000 cfm. By making provision for recirculation of small amounts of room air, we have been able to eliminate peak loads on the heating system during extremes in cold weather. This has made possible the delivery of large quantities of outside air during hot weather for area cooling, while maintaining a sensible heating cost during colder periods.

Delivery of the air, or distribution, is the most important single factor in the success or failure of any area air conditioning system. It is also the most expensive single component in such a system. For this reason, the design engineer is sometimes tempted to cheat a little on this component and the results are almost always a poor system, regardless of how well designed are the dampers, thermostatic controls, heating coils, and fan.

Fig. 2 shows a typical row of discharge outlets as installed at Weirton. This building houses a high-speed continuous annealing line. The building is 560 ft long, 121 ft wide, and 120 ft high. Adequate distribution here requires the use of 70 separate discharge outlets, each outlet composed of 6 vertical vanes preset for uniform air distribution. The outlets are located between 10 and 12 ft above floor level and are directed toward the floor at an angle of approximately 45 deg. The overhead crane shown in this building has complete freedom of travel for the entire length of the building. The location of the vertical drops between the crane rail and the siding are typical of all steel plant distributions. There are two 174,000 cfm heating and ventilating systems required for this building, for a total of 348,000 cfm. These systems were installed at a cost of less than 50 cents per cfm.

A large gravity ventilator (Fig. 3) is used to exhaust furnace heat and products of combustion. We are presently installing a second line parallel to the one of which Fig. 4 is a unit. Both of these furnaces exhaust directly from the building; we anticipate no fume problems, due to the supply of adequate make-up air under the proper conditions of distribution.

We have already installed 12 area heating and ventilating sys-

Figs. 3 and 4 Typical gravity ventilators as practical for steel plant

FIG. 3

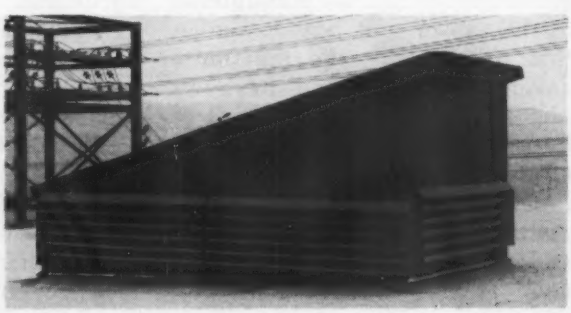


FIG. 4



tems of this design at Weirton for a total of two million cubic feet of conditioned air. Due to the many benefits derived from these systems in improving our plant environment, we plan to continue these installations in all areas of new plant construction.

Due to the rapid growth of the steel industry as previously mentioned, we at Weirton have been faced for several years with a critical shortage of floor space. For this reason, we have been attempting where possible to get nonessential operating facilities off the floor. This has resulted in the construction of central wash and locker rooms up in the roof trusses. Three years ago we constructed our first such washroom above a hot strip mill. This room is located directly above the mill, 30 ft above floor level and contains 18,000 sq ft of floor area and 2,600 lockers.

For heating and ventilation we installed six 10,000 cfm unit heater ventilators evenly spaced along one wall of the room. These units supplied 100 per cent make-up air. During warm weather the room temperature exceeded outside air temperature by as much as 35 F. Such a condition soon became unbearable so we found it necessary to install ducts and grills to distribute the air down each row of lockers. Although this arrangement reduced air temperatures by 20 to 25 F, it still left a great deal to be desired.

At the same time we were considering construction of a similar washroom in our tin mill. It was decided by management that the same mistake would not be made here, and Engineering was charged with the responsibility of installing the best ventilation system it could devise for this construction.

For this, there is an air distribution system consisting of a false floor 18 in. high, 59 ft wide and 237 ft long. Air is pumped into this plenum and distributed to the washroom from beneath each locker base. Fig. 5 shows a row of discharge outlet grilles beneath a typical locker base.

This system is sized to handle a maximum of 40,000 cfm of make-up air. There are eight 5,000 cfm exhaust fans located on the roof.



Fig. 5 Discharge outlets are located below lockers in roof truss installation

Control specifications for this system are designated as follows:

1 – With room temperature below thermostat setting, the return air dampers will be 100 per cent open, fresh air dampers 100 per cent closed and main steam valve open.

2 – As the room temperature reaches the lower end of the thermostat throttling range, the fresh air dampers open to 25 per cent, the return air dampers close to 75 per cent open, the steam valve remains open and roof exhaust fans connected to shower and toilet facilities will be started.

3 – As the room temperature continues to rise, the steam valve modulates toward the closed position, and the dampers remain as in step two.

4 – If the room temperature should continue to rise with the steam valve closed, the fresh air damper will modulate toward the 100 per cent open position, and additional roof fans in pairs will start at 50, 75, and 100 per cent open position.

5 – Should the air stream discharge temperature fall below the set minimum, the air stream thermostat will take control from the room thermostat and reposition the fresh air damper to the 25 per cent position, and will reposition the steam control valve if necessary to prevent the discharge of uncomfortably cool air.

We feel that such a system will eliminate the problems experienced in our first central washroom and provide a single system with fewer maintenance problems than were experienced with the use of several unit heater-ventilators. The system is designed to provide a minimum of 5 cfm of outside air per employee using this room and a maximum of 15 air changes per hr for hot weather ventilation.

WHAT OF THE FUTURE?

Industrial ventilation has evolved through many phases at a rather rapid rate, but there is no reason to feel that this evolutionary process will stand still. As long as we are dealing with human beings, we shall find that they are never satisfied for long with their environment. In industrial ventilation we went from open construction to roof monitors, then to man cooling fans and unit ventilators, and finally to area ventilation. What will be the next step in general ventilation?

I am convinced that it will involve some type of air cooling or conditioning. Most of us have already taken steps in this direction by air conditioning crane cabs and operating pulpits. At Weirton we have installed for the comfort of operational employees a total of 365 ton or 4,380,000 Btu of air conditioning, and this figure is increasing steadily.

We have a crane operating only three ft above the discharge stacks from an annealing furnace. Three years ago it was necessary to employ spell hands in order to operate this crane for short periods over the furnace. Following installation of heat shields, insulation, and a two-ton unit, the crane operator performs almost unlimited service in complete comfort over the furnace.

We have a hot mill speed operator who works in a comfortable air conditioned environment only 50 ft from a red hot strip mill. His pulpit is equipped with heat

absorbing glass and a five-ton water cooled air conditioning system.

With increasing advances in automation it may be possible to limit air conditioning to crane cabs, pulpits and other employee enclosures. It is more probable, however, that it will not be this simple, for although we have made significant advances in automation of operational jobs, we have done but little in automating maintenance. Maintenance employees must leave the sanctuary of our little industrial "isolation booths" and expose themselves to the natural industrial environment. For these employees it will be necessary to evolve to area evaporative cooling. The area ventilation system described in this paper could be quite easily converted to an evaporative cooling system. With such a conversion we could, through one single system, provide make-up air for dilution of contaminants, heated air for cold weather operation, and cool air for heat relief during hot weather. Such a suggestion, which sounds like a dream today, may well be a reality tomorrow.

This discussion is not presented upon the assumption that we have anything new for the ventilation industry but rather to state an acceptable approach to certain problems. Because payrolls are being inflated with more and more maintenance employees, systems must be installed which require the minimum of maintenance while at the same time producing maximum results in ventilation and heating.

Why stick with hit-skip methods of control using unit heaters and ventilators, which are constantly one step behind employee complaints and one step ahead of available maintenance? When designing a system or figuring the cost-life of a system, it is necessary to think beyond initial cost per cfm per sq ft and consider maintenance cost. In heavy industry a system, no matter how effective initially, will not operate one year after installation if maintenance needs are excessive.

In designing heating, ventilating, and air-conditioning systems today we must consider the problems of tomorrow. Try to design a system which will meet future demands as well as immediate needs. Our Engineering Department has made the installation of area heating and ventilating systems an integral part of all new construction. We feel that such a system is flexible enough to adapt to future demands for improved industrial environments and that the installation of one single system to cover a large plant area will keep maintenance problems to a minimum.

An alarming percentage of our citizens stops with the word "education" itself. It is for them a kind of conjuror's word, which is expected to work miracles by the very utterance.

Somewhat better off, but far from sufficiently informed and critical, are those who recognize that education must, after all, take some kind of form, that it must be thought of as a process that does something one can recognize. Most of these people, however, see education only as the means by which a person is transported from one economic plane to a higher one, or in some cases from one cultural level to another that is more highly esteemed.

Education is a process by which the individual is developed into something better than he would have been without it. For one thing, it involves the premise that some human beings can be better than others.

Education is discriminative. It takes what is less good physically, mentally and morally and transforms that by various methods and techniques into something that more nearly approaches our ideal of the good.

Every educator who presumes to speak about his profession has in mind some aim, goal or purpose that he views as beneficial.

For some while now there has been a movement among certain people styling themselves educators to disparage and even to do away with the very things that were once considered the reason for and the purpose of all education. There has been a bold and open attempt to deny that man has a nature which is fulfilled only when these higher faculties are brought into play, educated and used to make life more human in the distinctive sense.

Oddly enough, the movement has arrogated to itself the name "progressive". That seems a curious term to apply to something that is retrogressive in effect. These innovators are trying to give the impression that their theory of education is the only forward-looking one, and that the traditional ones are inherited from times and places that sat in darkness.

"Progressive" education does not foster individualism. It may have the specious look of doing so because it advocates personal experience as a teacher and the release of the natural tendencies of the person.

Individualism in the true sense is a matter of the mind and the spirit; it means the development of the person, not the well-adjusted automaton.

RICHARD M. WEAVER
Professor of English, University of Chicago

Why Refrigerant 22 should be favored for

Absorption refrigeration

The ideal absorption refrigerant would have

- **extremely high solubility**
- **high chemical stability**
- **low pressure**
- **low ferric decomposition**
- **long life**
- **good thermodynamic properties**



B. J. EISEMAN, JR.

Absorption refrigeration is, in principle, an attractive method for utilizing fuel directly for cooling and is being so used in practical applications at the present time. However, existing absorption systems suffer from certain deficiencies. The present study was undertaken with the objective of overcoming them.

Three types of systems deserve practical consideration at present: Those in which water is the refrigerant, those in which ammonia is the refrigerant, and those having a halogenated organic compound as the refrigerant.

The principal practical deficiency of water as the refrigerant is that a water-cooled-condenser system is required to reach even air-conditioning cooling levels and that refrigeration temperatures cannot be reached practically even with a water-cooled condenser. Other disadvantages of water, with salt solutions such as lithium bromide as absorbent, are its corrosive nature and the fact that extremely low pressures must be maintained, a condition which is made the more difficult to meet by corrosion.

While ammonia as the refrigerant (water as the absorbent) can be used with an air-cooled condenser, its toxicity, flammability and explosiveness when mixed with air must be considered. Moreover, the system is far from ideal in technical respects. Specifically, water is too volatile as an absorbent, and the system has an undesirably high operating pressure.

Most of these deficiencies can be overcome by a suitable choice of a fluoroalkane refrigerant, since these compounds are operative with air-cooled condensers and, being nonflammable and practically nontoxic, make direct cooling of peopled areas permissible. Of course, the coefficient of performance will be adversely affected by going to higher condenser temperature (or lower evaporator temperature), other things remaining unchanged.

Performance of Halogenated Absorption Refrigerants — The most commonly used refrigerant today is Refrigerant 12.* That being the case, an explanation is in order as to why it is not proposed as an absorption refrigerant. The primary reason is that Refrigerant 12 (CCl_2F_2) and other fully halogenated refrigerants such as Refrigerant 11 (CCl_3F), Refrigerant 113 ($CCl_2F{\cdot}CClF_2$) and Refrigerant 114 ($CClF_2{\cdot}CClF_2$) show only Raoult's law solubility or "normal" solubility in liquids which might be used as absorbents. What is wanted is highly abnormal, enormous solubilities, so that volumes and heat losses can be kept to a minimum. What is required is the largest possible difference in solubility between absorber conditions and generator conditions (which turns out to be the case when the solubility is extremely high as discussed more fully in later paragraphs). Among the halogenated alkanes, those having hydrogen as well as halogen in the molecule show the highest solubilities in absorbent liquids.

Six fluoroalkanes have been studied. In order of decreasing boiling point they are: Refrigerant 21 ($CHCl_2F$), Refrigerant 133a ($CH_2Cl{\cdot}CF_3$), Refrigerant 31 (CH_2ClF), Refrigerant 124a ($CHF_2{\cdot}CClF_2$), Refrigerant 134 ($CHF_2{\cdot}CHF_2$), and Refrigerant 22 ($CHClF_2$). A nonfluorinated compound, Refrigerant 30 (methylene chloride, CH_2Cl_2) is also included, since it has been used as an absorption refrigerant.

For a complete and detailed comparison of absorption systems, full, accurate information would be required on the heat capacity, vapor pressure, heat of vaporization, density, viscosity and thermal conductivity of the refrigerant, the absorbent and their solutions, together with their heat of mixing. Data also would be required on the rate of solution and disengagement of the refrigerant and the rate of heat transfer under the unit operating conditions. Such information is not completely available. However, it has proven feasible to make an adequate comparison of refrigerants on the basis of more limited data.

For this purpose, the published engineering data, of G. F. Zellhoefer for a Refrigerant 21 unit, using the dimethyl ether of tetra-

Dr. B. J. Eiseman, Jr., is with the Freon Products Laboratory, E. I. duPont de Nemours & Co., Inc. This is a somewhat condensed version of the paper, "A Comparison of Fluoroalkane Absorption Refrigerants", which was presented at the ASHRAE annual meeting in Lake Placid, N. Y., June 22-24, 1959. The complete paper will appear in ASHRAE Transactions.

* Freon and combinations of Freon- or F- with numerals are duPont's registered trademarks for its own offerings of fluorinated hydrocarbons.

TABLE I——COMPARISON OF THE PERFORMANCES OF ABSORPTION REFRIGERANTS

Refrigerant		21	133a	31	124a	134	22	1
Formula	Steps	$CHCl_2F$	$CH_2Cl \cdot CF_3$	CH_2ClF	$CHF_2 \cdot CClF_2$	$CHF_2 \cdot CHF_2$	$CHClF_2$	CH_2Cl_2
Molecular Weight		102.9	118.5	68.5	136.5	102.	86.5	84.9
Boiling Point, C		+8.9	+6.1	—9.1	—10.2	—23.	—40.8	+40.
Boiling Point, F		+48.1	+43	+16	+14	—9.4	—41.4	+104
Latent heat of vaporization at 40 F								
Btu. per lb	(1)	105.2	80.2	136.6	69.4	87.8	87.4	150.5
Btu. per lb mole	(2)	10,820.	(9,500)	9,360	9,470	8,950	7,560	12,780
Solubility in E-181								
Absorber								
Operating temperature, F		95	90	95	95	95	95	95
Operating pressure, psia.		12.3	13.8	24.2	26.1	41	83.7	3.3
Mole fraction refrigerant	(3)	0.680	0.630	0.601	0.590	0.613	0.748	0.523
Weight percent refrigerant	(4)	49.6	48.2	31.7	46.9	42.1	53.6	29.5
Moles refrigerant per mole E-181	(5)	2.125	1.703	1.506	1.439	1.584	2.97	1.096
Generator								
Operating temperature, F		232.	230.	232.	232	232	232.	232.
Operating pressure, psia.		42.9	46.3	72.3	81.4	115.	224.6	14.7
Mole fraction refrigerant	(6)	0.414	0.374	0.366	0.308	0.413	0.516	0.317
Weight percent refrigerant	(7)	24.7	24.2	15.1	21.5	24.4	29.3	15.0
Moles refrigerant per mole E-181	(8)	0.706	0.597	0.577	0.445	0.704	1.07	0.464
Refrigerant evolved in generator: (5) — (8) =	(9)	1.419	1.105	0.929	0.994	0.880	1.90	0.632
Vapor pressure of refrig., psia. at 104 F.	(10)	42.9	46.3	72.3	81.4	115.	224.6	14.7
Vapor pressure of refrig., psia. at 40 F.	(11)	12.3	13.8	24.2	26.1	41.	83.7	3.3
Pressure drop to absorber: (10)—(11)=	(12)	30.6	32.5	48.1	55.3	74.	140.9	11.4
(9) × (2) =	(13)	15,360.	10,500.	8,690.	9,413.	7,880.	14,364.	8,075.
Amounts Circulated, lb/min Per Ton Refrigeration								
Refrigerant circulated to evaporator	(14)	2.250	3.324	1.739	3.872	3.086	2.995	1.517
Corresponding amount E-181, based on (4) and (7):	(15)	3.425	5.643	5.025	6.343	7.641	4.051	6.284
Actual amount E-181 based on 75% eff. of absorber-generator system (15)/.75 =	(16)	4.567	7.524	6.701	8.457	10.187	5.401	8.379
Amount refrigerant in weak liquor based on (16)	(17)	1.494	2.397	1.192	2.316	3.269	2.238	1.479
Total amount refrigerant: (14) + (17) =	(18)	3.744	5.721	2.931	6.188	6.375	5.233	2.996
Total to generator (16) + (18) =	(19)	8.311	13.245	9.632	14.645	16.542	10.634	11.375
Specific gravity of liquid refrigerant at 60 F	(20)	1.379	(1.365)	(1.226)	1.299	(1.192)	1.213	1.336
Gal. refrigerant min/ton refrigeration, based on (18) and (20)	(21)	0.325	0.502	0.286	0.571	0.641	0.517	0.269
Gal./min/ton refrigeration based on (16) and sp. gr. 1.013	(22)	0.540	0.890	0.793	1.000	1.205	0.639	0.991
Total gal./min/ton refrigeration: (21) + (22) =	(23)	0.8656	1.392	1.079	1.571	1.846	1.156	1.260
Power Requirements								
Head + Frictional Losses psia.: (12) + 50 = (24)	(24)	80.6	82.5	98.1	105.3	124	190.9	77.4
Power per Ton Refrigeration								
Pump hp 0.000584 × (23) × (24) =	(25)	0.0408	0.0671	0.0618	0.0966	0.134	0.129	0.0452
Estimated actual hp: (25)/0.462* =	(26)	0.088	0.145	0.134	0.209	0.289	0.279	0.0978
Btu/min theoretically equivalent to (26):42.41 × (26) =	(27)	3.73	6.15	5.68	8.86	12.26	11.8	4.15
Btu/min "Practically" equivalent on a cost basis** to (26):(27) × 5.6 =	(28)	20.9	34.4	31.8	49.6	68.6	66.1	23.2
Heat Requirements								
Specific heat of liquid refrigerant at 77 F Btu/(lb)(F) =	(29)	0.255	0.313	0.337	0.292	0.359	0.298	0.287
Heat Capacity in Btu/(min) (ton refrigeration)								
Total refrigerant (29) × (18) =	(30)	0.955	1.791	0.988	1.807	2.289	1.559	0.860
Total E-181: 0.447 × (16) =	(31)	2.041	3.363	2.995	3.780	4.554	2.414	3.745
(30) + (31) =	(32)	2.996	5.154	3.983	5.587	6.842	3.973	4.605
Ratio to value for Refrig. 21: (32)/2.996 =	(33)	1.000	1.720	1.329	1.865	2.284	1.326	1.537
Over-all Comparison with Refrig. 21								
Heat required to raise weak liquor from 95 to 232 F Btu/(min) (ton)								
Heat required by refrigerant 137 × (17) × (29) =	(34)	52.2***	102.8	55.0	92.6	162.1	91.4	112.0
Heat required by absorbent 137 × (16) × 0.447 =	(35)	279.7	491.7	437.9	517.9	665.7	330.7	513.1
Total: (34) + (35) =	(36)	331.9	594.5	492.9	610.5	827.8	422.1	625.0
Ratio of values to Refrig. 21 value: (36)/331.9 =	(37)	1.00	1.79	1.49	1.839	2.49	1.27	1.88
(These ratios are also the ratios of the respective total heat requirements within our accuracy).								
Percentage excess over Refrig. 21 values								
Due to increased heat requirements (37 — 1.00) × 100 =	(38)	0	79	49	84	149	27	88
Due to increased power requirements 100 (28) — 20.9)/(333 + 20.9) =	(39)	0	3.8	3.1	8.1	13.5	12.8	0.7
Total (38) + (39) =	(40)	0	83	52	92	163	40	89
Coefficient of Performance (For Refrig. 21; COP = 200/533 = 0.375)								
$COP = \frac{0.375}{(100 + (40))/100} =$	(41)	0.375	0.205	0.247	0.195	0.143	0.268	0.198

* Pump efficiency of 0.66 times motor efficiency of 0.70. ** Cost per kw-hr 2c and cost per therm. 10.5c.
*** Value from the thermodynamic tables instead of approximate calculation indicated by the equation.

ethylene glycol* as absorbent have been used as a standard of comparison. The comparison of the six other refrigerants with Refrigerant 21 has been made on a ratio basis, so that the relative merits of the refrigerants are established independently of the specific machinery used. That is, any improvement or change in such factors as spraying or heat transfer should affect all of the refrigerants similarly, leaving their relative order of performance unchanged. The dimethyl ether of tetraethylene glycol was used by Zellhoefer as the best absorbent available. His choice has been confirmed by our tests.

New solubility data from Jackson Laboratory of duPont** and published thermodynamic data have been used in preparing the Table.

In Table I the arrangement of the fluoroalkane refrigerants is that of decreasing boiling point from left to right. The only nonfluorinated compound, Refrigerant 30 (methylene chloride) is not placed in order of boiling point but is in the last column. It properly belongs by itself because of its low stability as compared to the fluorinated refrigerants. Stability is discussed later.

The end result of the calculation is expressed in item (41), the coefficients of performance (COP). Rearranging on the basis of the order of COP, we have:

Refrigerant		
21	($CHCl_2F$)	0.375
22	($CHClF_2$)	0.268
31	(CH_2ClF)	0.210
133a	($CH_2Cl \cdot CF_3$)	0.205
30	(CH_2Cl_2)	0.198
124a	($CHF \cdot CClF_2$)	0.195
134	($CHF_2 \cdot CHF_2$)	0.143

Refrigerant 21 thus is best on the basis of its thermodynamic and physical properties. Unfortunately, its chemical stability is not good. Refrigerant 22, in second place in COP, is excellent in chemical stability and is the preferred fluoroalkane refrigerant.

It is to be emphasized that the COP of 0.268 for Refrigerant 22 is for the specific equipment and cycle of Zellhoefer. In this cycle the efficiency of the absorber-generator system is 75% as compared to theoretical solubilities and the recovery of heat from the liquor leaving the generator is less than 37%. Any considerable improvement in these figures by more effective spraying or better heat transfer would lead to considerable improvement in the COP.

The least desirable feature of Refrigerant 22 as an absorption refrigerant is its relatively high pressure, which leads to power requirements more than three times as great as for Refrigerant 21 (see item (26), Table I). The additional power, however, need not be

* DME-TEG; Ansul ether E-181.
**S. V. R. Mastrangelo, "Solubility of Some Chlorofluorohydrocarbons in Tetraethylene Glycol Dimethyl Ether", ASHRAE JOURNAL, October 1959, pp. 64-68.

TABLE II COMPARISON OF ABSORBENT-REFRIGERANT PAIRS

Absorbent	Molecular Weight	Boiling Point F	Freezing Point F	Temperature Rise, F., on mixing equal liquid volumes of absorbent and refrigerant: Refrig. 22 ($CHClF_2$)	Refrig. 21 ($CHCl_2F$)	Refrig. 30 (CH_2Cl_2)	Refrig. 31 (CH_2ClF)
Dimethyl ether of tetraethylene glycol (DME-TEG)	222	527	<— 22	24.3	23.4	22.1	14.4
Cyclohexanone	98	311	— 49	17.1	15.3	10.8	7.6
Tributyl phosphate	266	552	<—112	—	14.4	8.1	—
Acetophenone	120	396	+ 69	9.9	9.0	5.4	4.5
Isophorone	138	419	—	12.6	9.0	7.2	0.9

TABLE III COMPARISON OF ABSORBENT — CH_2Cl_2 PAIRS

Absorbent	Temp. Rise on Mixing Equal Liquid Volumes, F
1-Ethyl-3-methyl-phospholine-1-oxide	25.9
Tetraethylene glycol dimethyl ether (DME-TEG)	22.1
DME-TEG/Tetramethylurea (75/25 by volume)	21.2
DME-TEG/Tetramethylurea (50/50 by volume)	20.9
DME-TEG/Tetramethylurea (25/75 by volume)	19.4
Tetramethylurea	18.4
N, N-Dimethylacetamide	17.6
Dimethyl sulfoxide	12.6
N, N-Dimethylformamide	12.6
2, 6-Lutidine, N-oxide	12.6
Diisobutyl phosphite	12.6
Tetrahydrofuran	11.2
Diethylcyanamide	11.0
Cyclohexanone	10.8
Adiponitrile	10.8
Diisopropylcyanamide	9.9
Experimental Polyketone A	9.9
Tributyl phosphate	8.1
Dimethylcyanamide	7.7
Isophorone	7.2
Polyethylene glycol 200	7.2
Experimental Polyketone B	7.2
Tetramethylene sulfone	6.7
Ethyl ether	6.3
Acetone	6.3
N-Methylformamide	5.6
Acetophenone	5.4
Methyl sulfite	5.4
Triethyl amine	5.4
Experimental Polyketone C	5.2
Pyridine	5.0
Ethyl sulfide	3.6
Nitropropane-1	3.6
Ethylene phosphite	3.6
Experimental polyketone D	3.6
Acetylated monoglycerides (Eastman Type-940)	2.7
Ethylsulfonylethanol	2.7
Acetic acid	1.8
Triisobutyl phosphite	1.8
Experimental polyketone E	1.8
1, 4-Butanediol	0
Butyl disulfide	0
Poly(ethylenimine)	0
Dimethyl sulfolane	—1.8
Dow Corning Silicone #200	—2.7
Dow Corning Silicone #1107	—2.7
Dow Corning Silicone #1108	—2.7
Aniline	—3.6
Methanol	—3.6
Anhydrous ethanol	—7.2
95% Ethanol	—9.4

TABLE IV

COMPARISON OF STABILITIES OF REFRIGERANTS 21 AND 30

System: 2 cc Refrigerant + 2 cc Naphthenic Oil or DME-TEG + metals
Temperature: 250 F.

Refrigerant	Duration Test (Days)	Refrig. Decomposed (%)	Penetration (in./mo × 10⁶) Aluminum	Copper	Steel	Comments
		A. Tests with naphthenic oil				
21	1	0.003	420	2,000g	500g	
30	1	4.0	130,000	1,800g	1,500g	general decomposition in one day
30	1	x	x	x	x	carbonized in one day
		B. Tests with DME-TEG absorbent				
21	8	0.34	100	260g	140g	
30	8	10.2	40,000	160g	220	average of two tubes

x = no data
g = gain in weight
Note: Refrigerants: highest purity, center-cut material

TABLE V

COMPARISON OF STABILITIES OF REFRIGERANTS 12, 21 AND 22 WITH NAPHTHENIC OIL PRESENT

System: 2 cc Refrigerant + 2 cc Naphthenic Oil + Copper + Mild Steel
Temperature: 250 F. Duration: 60 days

Refrigerant	Refrigerant Decomposed (%)	Penetration (in./mo × 10⁶) Copper	Steel	Comments (avg of)
22	0.001	2	7	3 tubes
12	0.032	1	13	2 tubes
21	0.21	4	13	2 tubes
21*	x	6	19	2 tubes

*Highest purity, center-cut material; other refrigerants are commercial grade (99.8 + %)
x = no data

TABLE VI

COMPARISON OF STABILITIES OF REFRIGERANTS 21, 22 AND 31 WITH DME-TEG ABSORBENT PRESENT

System: 2 cc Refrigerant + 2 cc DME-TEG + Copper + Mild Steel
Temperature: 250 F. Duration: 60 Days

Refrigerant	Penetration (in./mo × 10⁶) Copper	Steel	Comments
22	3	6	
31	4	42	
21	470	1200	Strong corrosion
21*	490	1100	Strong corrosion

Note: Each entry is the average of two tests.
*Highest purity, center-cut material; other refrigerants are commercial grade (99.8 + %)

TABLE VII

STABILITY TESTS ON SINGLE LIQUIDS

System: 2 cc Liquid + Copper + Mild Steel
Temperature: 250 F Duration: 60 Days

Liquid	Penetration (in./mo × 10⁶) Copper	Steel	Comments
Refrigerant-21	5	9	Slight corrosion
DME-TEG	3	5	Metals bright

Note: Results are average of two tests

wasted, since with correct design it can, in considerable part, be utilized to decrease film coefficients in the heat exchanger. Stating this in another way: It would be necessary to put power in to achieve good heat transfer, were it not that this power has already been made available in pumping from the low side to the high side.

The factors having the largest effect on performance are the difference in solubility of the refrigerant in the absorber and in the generator and the latent heat of the refrigerant. The best solubility characteristics are exhibited by Refrigerant 22. This may be seen from Item (9), Table I, which gives the moles of refrigerant evolved in the generator per mole of DME-TEG circulated. Despite its relatively poor solubility characteristics, Refrigerant 31, is in third place in coefficient of performance because its high latent heat per pound entails circulation of comparatively little refrigerant. The latent heat of Refrigerant 22 is relatively low, so that its COP falls behind that of Refrigerant 21 which has a better latent heat, and solubility characteristics only moderately below those of Refrigerant 22.

As discussed above, a major problem in absorption refrigeration is that of keeping the quantity of absorbing liquid small. To do this, it is necessary to have a large difference in solubility of the refrigerant in the absorbent between the absorber conditions and the generator conditions. This entails a large change in solubility with temperature. In order to have a large decrease in the solubility of the refrigerant with increasing temperature, there must be a large evolution of heat on mixing the liquid refrigerant and absorbent. Whence it results that to a good degree of approximation, the temperature rise due to the heat of mixing the liquid refrigerant and absorbent gives a measure of the absorbent-refrigerant pair's solubility properties. This temperature rise is not only the simplest relevant measurement, but is at the same time the best, short of a detailed analysis based on complete data.

This principle has been applied in obtaining the data in Tables II and III.

In Table II there is a comparison of the temperature rise of four refrigerants, Refrigerant 22, Refrigerant 21, Refrigerant 30, and Refrigerant 31, with absorbents.

The data of Table II show the same order of temperature rise with the several absorbents, with Refrigerant 22 highest, Refrigerant 21 next, then Refrigerant 30 (methylene chloride) and finally Refrigerant 31. Accordingly, if we know, for a series of absorbent candidates, the temperature rise with one of these refrigerants, we can reach conclusions as to the relative rise with other refrigerants. Thus, it suffices to measure the temperature rise with Refrigerant 30, which is especially convenient since pressure apparatus is not required in handling it. Extensive measurements with Refrigerant 30 are reported in Table III. The figures of Table III are comparable among themselves, but are not always identical with those of Table II, since different apparatus was used (consisting simply of graduated cyl).

The data of Tables II and III show the dimethyl ether of tetraethylene glycol (DME-TEG) to

TABLE VIII

EFFECT OF TEMPERATURE ON STABILITY OF REFRIGERANT 22 - DME-TEG SYSTEM WITH VARIOUS METAL COMBINATIONS

System: 2 cc Refrigerant 22 + 2 cc DME-TEG + metals

Temp (F)	DME-TEG*	Refrig. Decomposed (%)	Penetration (in./mo × 10⁶) Aluminum	Copper	Steel	Duration of Test (Days)	Number of Tests
250	commercial	0.001	7	2	2	61	3
300	commercial	0.12	9	5	12	90	3
300	anhydrous	0.19	11	2	16	90	1
350	commercial	0.13	15	1	13	90	3
350	anhydrous	0.13	15	2	17	90	2
300	commercial	0.15	—	2	17	90	3
300	anhydrous	0.33	—	1	37	90	2
350	commercial	0.030	—	2	9	90	3
350	anhydrous	0.046	—	4	36	90	2
300	commercial	0.003	4	1	—	90	3
300	anhydrous	0.002	6	2	—	90	2
350	commercial	0.003	2	2	—	90	3
350	anhydrous	0.002	1	2	—	90	2

*Commercial DME-TEG: 460 ppm moisture; 2.3 mg "active hydrogen" per 100 ml (by a lithium aluminum hydride method)
"Anhydrous" DME-TEG: 35 ppm moisture; 1.75 mg "active hydrogen" per 100 ml (by a lithium aluminum hydride method).

have most desirable solubility properties. It also has a favorably low vapor pressure and viscosity and is reported to be low in toxicity. Furthermore, it has good chemical stability. The only substance in Table III giving a greater temperature rise, 1-ethyl-3-methyl-phospholine-1-oxide, failed to show good stability with Refrigerant 22.

Other conclusions from the data of Tables II and III are:

1. In addition to polyethers, other desirable configurations for high solubility are carbonyl, sulfoxide, N,N dialkyl amide, P-oxide, N-oxide and nitrile.

2. Mixtures of the dimethyl ether of tetraethylene glycol (DME-TEG) with tetramethyl urea showed essentially additive properties.

The chemical stability of a system depends not merely on the stability of the individual components, but also on their mutual effects, which may be large. Therefore, all the components should be included simultaneously in stability tests. In view of the results of our study of absorbents, above, the dimethyl ether of tetraethylene glycol (DME-TEG) was selected as the absorbent to be used in the stability tests.

It is concluded that:

1. The only nonfluorinated refrigerant studied, Refrigerant 30, is far inferior in stability to Refrigerant 21, as may be seen in Table IV. This is true both with DME-TEG absorbent and with refrigeration-grade oil.

2. However, Refrigerant 21 itself shows relatively poor stability, decomposition being appreciable within a few days at 250 F in all Refrigerant 21 systems tested. In particular, in Table V, Refrigerant 21 is much inferior to Refrigerants 12 and 22 with naphthenic oil, copper and mild steel at 250 F. Similarly, Refrigerant 21 is shown, in Table VI, to be much inferior to Refrigerants 31 and 22 with DME-TEG absorbent, copper and mild steel. That the DME-TEG is not responsible is shown in Tables VII and IX. While Refrigerant 21 alone is not much worse than DME-TEG, Table VII, the low stability of the mixture must be attributed to Refrigerant 21, in view of the data of Table IV showing low stability for the Refrigerant 21 DME-TEG mixture and Table VIII showing that replacement of Refrigerant 21 in this mixture with Refrigerant 22 leads to high stability.

3. Refrigerant 31 is much better in stability than Refrigerant 21, but appreciably inferior to Refrigerant 22. This is shown by the data of Table VI.

4. Refrigerant 22 shows excellent chemical stability with DME-TEG absorbent with aluminum, copper and steel at temperatures up to at least 350 F, as may be seen in Table VIII.

5. In the Refrigerant 22 + DME-TEG systems (Table VIII), least decomposition occurs in the absence of mild steel. However, the amount of decomposition is small even when steel is present.

6. In the Refrigerant 22 + DME-TEG systems (Table VIII) no gain in stability is indicated for a reduction in moisture in the absorbent from 460 ppm (commercial grade DME-TEG) to 35 ppm ("anhydrous" DME-TEG). What difference there is, is in favor of the commercial grade.

7. In the Refrigerant 22 + DME-TEG systems, the effect of raising the temperature from 250 to 300 F was to increase the attack, as was to be expected. However,

TABLE IX

EFFECT OF DME-TEG ON VARIOUS METAL COMBINATIONS AT VARIOUS TEMPERATURES

System: 2 cc DME-TEG + Metals

Temp (F)	DME-TEG*	Aluminum	Penetration (in./mo × 10⁶) Copper	Steel	Duration of Test Days	Number of Tests
250	commercial	none	3	5	60	2
300	commercial	none	1	1	90	1
350	commercial	none	2	2	90	1
300	anhydrous	3	1	3	90	1
350	anhydrous	2	0	2	90	1
300	commercial	4	2	none	90	1
350	commercial	3	1	none	90	1

*Commercial DME-TEG: 460 ppm moisture; 2.3 mg "active hydrogen" per 100 ml (by a lithium aluminum hydride method)
"anhydrous" DME-TEG: 35 ppm moisture; 1.75 mg "active hydrogen" per 100 ml (by a lithium aluminum hydride method)

unexpectedly, this was not the case on raising the temperature from 300 to 350 F.

8. In the absence of refrigerant, DME-TEG alone, commercial or "anhydrous," does not attack aluminum, copper and mild steel appreciably (Table IX) at temperatures up to 350 F.

9. In the case of Refrigerant 22 + DME-TEG, mild steel has only a small adverse effect on stability at 300 and 350 F, as pointed out under 5 above. However, in the cases of Refrigerant 31 and especially Refrigerant 21 + DME-TEG, the adverse effect of steel is pronounced even at 250 F, as may be seen in Table X. In the absence of steel, other metals, namely aluminum, copper and 18-8 stainless steel, were little attacked and Monel was affected only slightly more.

It then appears that only Refrigerant 22 can be expected to provide long life in the systems considered, when mild steel is present. The Refrigerant 22 systems show good stability under the relatively severe conditions represented by 90 days at 350 F.

Of the halogenated absorption refrigerants, Refrigerant 21 would be the most attractive, were it not for its relatively poor chemical stability. Refrigerant 22, with excellent chemical stability, a necessity for long useful life of practical units, as well as good thermodynamic properties is the preferred halogenated refrigerant. After an extensive study, the dimethyl ether of tetraethylene glycol (DME-TEG) remains the preferred absorbent. The basis for our conclusion that the Refrigerant 22-DME-TEG system is attractive has been developed fully above. How does this fluoroalkane refrigerant system compare with others?

Table XI cross compares the principal systems with regard to important characteristics. If the units are to be air cooled, the lithium bromide-water system is excluded. If refrigeration, not air conditioning, is the objective, the lithium bromide-water system is excluded. The water-ammonia system is dangerous because of the toxicity and flammability of ammonia and the explosive character of its mixtures with air. In all of these respects the Refrigerant 22 system is superior. However, it must be borne in mind that DME-TEG, although not easily ignited, in view of its flashpoint of 285 F, will burn if heated hot enough. Its presence means we do not have the complete freedom from flammability hazards which Refrigerant 22 itself possesses. Also it must be remembered that while the Refrigerant 22 + DME-TEG system can be used with an air-cooled condenser or a low temperature evaporator, the coefficient of performance will decrease as the condenser temperature increases or the evaporator temperature decreases, if the other things remain unchanged.

In the matter of materials of construction, the Refrigerant 22 system offers more flexibility than the others. Iron, copper, aluminum and many alloys can be used. Lithium bromide solution is corrosive, requiring special alloys. Ammonia is incompatible with copper.

While all of the systems considered in this study have certain deficiencies it is clear that the Refrigerant 22-dimethyl ether of tetraethylene glycol system has enough advantages to merit careful consideration for all absorption refrigeration applications.

TABLE X

TABLE X EFFECT OF VARIOUS METALS ON THE STABILITIES OF REFRIGERANTS WITH DME-TEG ABSORBENT

System: 2 cc Refrigerant + 2 cc DME-TEG + metals
Temperature: 250 F Duration: 60 Days

Refrigerant	Refrig. Decomposed (%)	Penetration (in./mo × 10^6) Aluminum	Copper	Steel	18-8 Stainless Steel	Monel	Comments
		A. Combinations Excluding Mild Steel					
31	0.08	1g	0	—	—	—	
31	0.10	7	3	—	1g	—	
21	x	—	2	—	3	—	
21	x	2g	—	—	6	9	Monel tarnished
		B. Combinations Including Mild Steel					
22	x	—	3	6	—	—	
31	0.43	—	4	42	—	—	
21	x	—	490	1,100	—	—	Strong Corrosion
21	x	6,400	—	510	—	—	Aluminum partly eaten away
21	x	—	—	640	570	—	Metals badly corroded
21	x	—	—	1,200	—	400	Metals badly corroded

x = no data
g = gain in weight
Refrigerants 21 and 31 are highest purity center-cut material; Refrigerant 22 is commercial grade (99.8 + %).

TABLE XI RELATIVE MERITS OF THREE ABSORPTION SYSTEMS

Characteristic	Refrigerant-Absorbent Pair: Water-Lithium Bromide Solution	Ammonia-Water	Refrig. 22-DME-TEG
Can be air cooled	no	yes	yes
Can be used for refrigeration	no	yes	yes
Refrigerant nonflammable	yes	no	yes
Refrigerant nontoxic	yes	no	yes
Absorbent nonflammable	yes	yes	no*
Absorbent nontoxic	yes	yes	yes
Components noncorrosive	no	yes**	yes
Nonvolatility of absorbent	excellent but tends to foam over	poor	good
Latent heat of refrigerant	excellent	good	fair
Operating pressure	extremely low	high	high

*Flash point of absorbent is high, 285 F
**Corrosive to copper so that copper and copper alloys must be excluded

Investigating noise

from refrigerator compressors



R. C. BINDER

Approaching the noise problem from the point of view of an engineer who wishes to make a systematic study, with quantitative measurements and a minimum of trial and error, Author Binder has relied upon the specialized applicability to household refrigerator compressors of various methods available for the investigation of machine noises.

Any study of noise involves two different phases: (1) purely physical or engineering, (2) purely human. One of the simplest physical measurements to make is to use a sound level meter. Sound from a machine acts on the microphone of the meter. This meter can be used to determine the overall sound-pressure-level, SPL, which is defined as

$$\text{SPL} = 20 \log_{10} \frac{P}{0.0002} \text{ decibels} \quad (1)$$

where P is the root-mean-square sound pressure, in dynes per sq cm, and 0.0002 is a reference pressure in the same units as P. The single reading of overall sound-pressure-level, however, may not be sufficient. "Noise" is defined as "unwanted sound." For example, two different sounds with the same overall SPL may provoke different human responses; one sound may be regarded as quiet or allowable, whereas the other sound may be regarded as "noise" by a human jury.

A much better method of measuring sound characteristics is to determine the sound frequency spectrum, or simply the sound spectrum, as illustrated in Fig. 1. The sound-pressure-level, in decibels, is plotted as a function of frequency, in cps. Two different curves are necessary in a study of noise. In Fig. 1 the curve marked "machine" is determined by an engineering or physical measurement, with suitable instruments, of the machine itself.

The other curve in Fig. 1 marked "human" represents the sound-pressure-level which a human jury evaluation regards as the limit of allowance or acceptance. The human allowance curve might be measured in various ways, as by a test of an established quiet machine. Sound pressure levels above this allowance curve are objectionable, whereas levels below this allowance curve are acceptable. Consider frequencies below A; in this range the human allowance is higher than the machine sounds, therefore, the machine sound is not noise. Consider frequencies above A; in this range the human allowance is lower than the machine sounds, therefore, the machine sound is "noise." Plots of the type illustrated in Fig. 1 can be used to specify noise in a definite scientific manner.

The human allowance curve may depend on a number of factors: the location of the machine; the purpose or activity in the specific location; the time of operation of the machine; and the people who might be listening to the machine.

Different criteria might be used to establish the human allowance curve. The different criteria might be divided into two general groups: one loudness and the other annoyance. Loudness and annoyance are not the same. There are many sounds that can be annoying, although not loud. For example, various intermittent sounds, such as a dripping faucet, can be annoying, although they are not truly loud. A loud sound is one at a relatively high sound-pressure-level; a loud sound may be noise because it interferes with speech or it may cause damage to the ear. An annoying sound may be a low level sound which has certain undesirable frequency characteristics.

A household refrigerator may be a low level sound, yet be noisy because it is annoying. At the present time not enough data are available to establish just what annoyance is. Some preliminary tests at Purdue indicate that annoyance is caused by high frequency components, above about 7,000 cps, and by discrete frequency components. For example, a low level metallic clicking, or intermittent action, may

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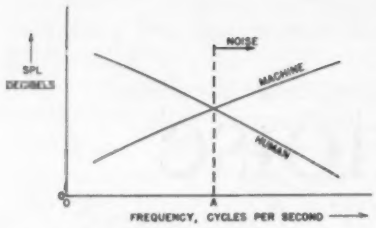


Fig. 1 Sound spectrum for a machine and sound spectrum for human allowance

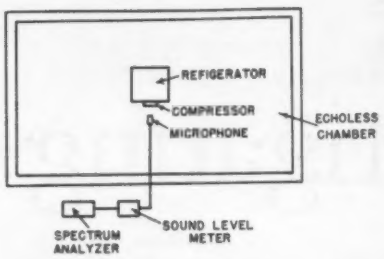


Fig. 2 General arrangement of test facility

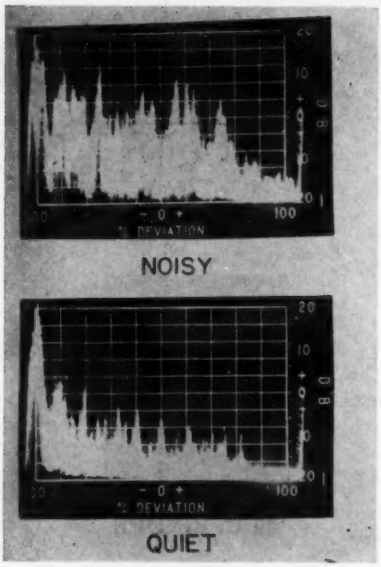


Fig. 3 Spectrum analyzer traces for two different refrigeration compressors

be annoying. Apparently the usual human response is to accept the more familiar low frequency sounds more readily than the less common high frequency sounds.

TEST FACILITY ARRANGEMENT

Different test arrangements are possible. One general arrangement for a certain class of problems, as illustrated in Fig. 2, has various advantages. The compressor to be studied is connected to its load, and the entire refrigeration system is installed in a echoless or anechoic chamber. A microphone is placed close to the compressor. The signal from the microphone is led outside of the chamber to a sound level meter; this meter gives a single reading of overall sound-pressure-level. The signal from the sound meter is led into a spectrum analyzer, which gives a plot of sound-pressure-level versus frequency, of the type shown in accompanying Fig. 1.

In an echoless chamber all the walls are so arranged that they absorb the incident sound, which comes from the machine. Fiberglas wedges provide a good absorbing material.

At Purdue we built an echoless chamber with net inside dimensions of 16 x 12 x 7 ft. The Fiberglas wedges were 24 in. long (perpendicular to the wall), and mounted on all interior surfaces. A wire mesh floor was installed above the bottom wedges. These wedges absorbed all frequencies above about 170 cps. This Purdue echoless chamber proved quite suitable for various studies of household refrigerators, and other machines. The echoless chamber provides a controlled environment for doing detective work. A completely closed room isolates the testing area from other sources of noise, and provides a low background sound level. A microphone in the chamber picks up only the sound from the machine under test.

Suitable microphones and sound level meters are available commercially. Various frequency analyzers are available commercially, as the octave-band analyzer, sound analyzer, and the spectrum analyzer. In considering a frequency instrument for low level annoyance studies, it should be recognized that measurements of high frequencies may be quite important, up to about 15,000 cps.

The spectrum analyzer is one type of instrument that is especially helpful in many noise studies. In this instrument, a cathode-ray tube gives the spectrum which can be photographed. An electron beam is swept horizontally about once a second. The horizontal sweep is so arranged that each horizontal position corresponds to a certain frequency. The applied sound pressure gives a vertical deflection to the beam. Fig. 3 shows the spectrum analyzer traces for two refrigeration compressors. In each trace the vertical scale is sound-pressure-level, in decibels, while the horizontal scale is frequency, in cps, with the left end of the scale zero and the right end 20,000 cps.

In Fig. 3 the upper trace is for a noisy compressor, whereas the lower trace is for a quiet compressor. Each compressor had essentially the same low overall sound level. Each was designed for the same loading system. A comparison of the two shows the difference between the two machines. The photographic negative for each trace can be used to make a comparison of the frequency spectra. Fig. 4 illustrates one type of comparison plot. For each frequency, the difference, in SPL, for the one compressor minus the SPL for the other compressor, is plotted.

Such a plot brings out the difference between the compressors, and shows what has to be changed in order to get one machine to match another machine. The spectrum analyzer is notably convenient, in giving an immediate picture of the sound spectrum. Compressor operation can be changed and the corresponding changes noted immediately. Other types of analyzers may be used if other features are desired.

The foregoing discussion indicates a method for studying a noisy compressor, and pointing out with quantitative measurements, just what results should be obtained in order to get a quiet compressor.

In some studies of noise location and detection, it would help if one or more sound probes could be inserted inside the sealed case. The general idea is illustrated diagrammatically in Fig. 5. If a sound measurement could be made inside the case, it could tell more about the sources of noise, and eliminate the question of just what is transmitted through the case. If two microphones, some distance apart, could be inserted through the case and moved about, then a sound ranging technique might be used to identify sources.

One might consider a microphone inserted through the case, or

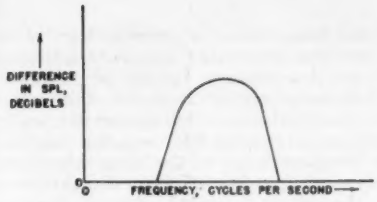


Fig. 4 Illustration of plot in which the difference in sound-pressure-level, SPL, between two machines is plotted as a function of frequency

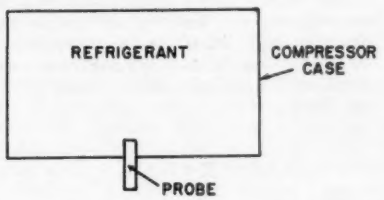


Fig. 5 Diagram of probe arrangement

a microphone connected to a tube which passes through the case. There is the problem of sealing the microphone during the period when the compressor is charged with refrigerant, and during normal operating conditions. If a tube connected to a microphone is used, then there is a problem of interpreting the reading of the microphone. Unfortunately, the sealed case of a refrigeration compressor presents a number of difficult problems which have not yet been resolved in a truly simple and convenient manner.

Sometimes the question arises as to the possible use and value of a so-called "reverberation chamber." A reverberation room (or chamber) is an enclosure in which the surfaces are hard (as smooth plaster) in order to give as much sound reflection as possible. With a source of sound in such a room, there is a region in which the sound is diffuse and the sound-pressure-level is uniform. This makes it possible to arrange a convenient measurement of the sound power emitted by the sound source. The sound power is of value in certain studies, as in machine rating and in studies of absorption. In certain other studies, however, as those of location of sound sources and certain studies of noise reduction, the sound power may not be of real value. The reverberation chamber is useful for certain studies, and the echoless chamber is useful for certain other studies.

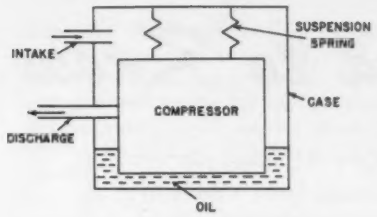


Fig. 6 Diagram of compressor unit

COMPRESSOR ARRANGEMENT

Different types of compressor tests are possible. In some tests the objective may be to locate a major source or sources of sound. In some tests the objective may be to determine the effectiveness of a noise reduction device, as a muffler.

Consideration may be given to tests in which the compressor is operated with air, a vacuum, or with nitrogen. Tests might be made with some part removed, as a valve plate, piston, and connecting rod. Tests of this sort may be convenient, but the results may not be significant if the compressor is not operated with its normal refrigerant charge, normal load, and normal assembly of parts. It is most desirable to operate a compressor with its normal charge and load. One way of expediting testing is to arrange the casing with split bolted flanges so that the compressor can be dismantled and assembled easily.

Masking—In a machine there may be different noise sources, and there may be different paths from a single noise source to the human ear. In either case it is important to recognize the feature of "masking". Frequently, confusion results because this feature of masking is ignored. As an example, say there are two separate noise sources, one A and the other B in a machine. Say A is at a higher sound level than B. A masks or covers B. Reducing further the sound level of B will not weaken the sound level A which reaches the ear.

As another example, say there is only one noise source, but two separate sound paths, one A and the other B, from this source to the human ear. One path may short circuit the sound; the situation is similar to that in an electric circuit. Say A is the better path (less resistance to noise transmission) whereas B is the poorer path (greater resistance to noise transmission). Reducing the transmission through B does not reduce the transmission through path A. A masks or covers B. If path A is weakened below B, then B can be heard.

Possible Tests—In some cases it may be a difficult job to locate major noise sources in a refrigeration compressor. It may require considerable ingenuity to get an answer.

If foaming in the oil is suspected as a possible source of noise, various silicone anti-foam or defoaming agents are available for trial. Addition of a small quantity of a defoaming agent to the oil will cure the foaming. Thus a relatively simple test can be made to determine if foaming is a noise source.

In low-level annoyance cases, a valve impact action may be suspected as a source of noise. If it is too difficult, or otherwise unwise to cure the noise at the source, attention may be given to blocking the transmission from the source to the ear. This case illustrates a method of noise control which may be wise to follow in various other cases.

Fig. 6 illustrates diagrammatically a system with a reciprocating compressor. The noise can travel from the valve impact region through the compressor frame. This noise can pass through the metal suspension springs, the metal discharge pipe, and the oil bath to the outer case. From the case the noise travels through the air to the human ear. If the sound transmission through these three paths is blocked, then the listener will not hear the noise. A flexible tube can be placed in the discharge pipe to block transmission. Various elastomers and metal mesh mounting materials can be used in place of conventional steel springs to block transmission. Various means can be employed to isolate the oil bath from the case and thus block the paths. Tests with and without these modifications can be used to determine the effectiveness of the different noise reduction methods.

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters cover many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and specific value to ASHRAE members.

WITH PLASTICS PIPES

To ASHRAE:

One of our customers is interested in portable ice skating rinks and would like to use plastics piping for that purpose. It seems likely that there is more information on this subject available in your country than in ours (France). Could you help us?

P. J.

The initial cost of a take-up type of ice skating rink is much less than that for other designs since lightweight plastics piping, through which the cooling medium may be circulated, can be laid upon a floor or any other hard-surfaced court, ball field or level ground. During summer months the pipes can be taken up and stored until needed again. Worthington Corporation has published a bulletin, "Ice Rinks, Permanent and Portable" which might be helpful to you.

ABSORPTION REFRIGERATION

To ASHRAE:

In a lithium bromide absorption system, what methods are employed for removing heat from the absorber other than cooling towers? What methods are employed for supplying absorbent solution and water to absorber and evaporator respectively? What inert gases can be used in such a system, as is hydrogen with ammonia water systems, to prevent operation in a near vacuum? What arrangements are employed in fabricating the evaporator and absorber? What problems would arise if a lithium bromide solution were supplied to the evaporator instead of pure water at a concentration less than that entering the absorber?

P. S. B.

On the specific 3-ton unit about which you inquire heat is removed from the absorber by means of cooling water flowing through the absorber coil; the latter is not air cooled. The absorbent solution is distributed over the absorber coil by means of drippers. No inert gas is used with the lithium bromide system as the presence of one would interfere seriously with the operation of the absorber. For smaller systems using a direct expansion evaporator, the evaporator is separated from the absorber coil but in water chillers both units are in the same shell.

Temperature differences between the evaporator and absorber coils are so small that radiation losses are insignificant. Convection is no problem because convection currents are simply water vapor going from the evaporator coil to the absorber coil. Should lithium bromide solution be supplied to the evaporator instead of pure water, the evaporator temperature will rise for any given set of absorber conditions. This increase in temperature is quite small for concentrations up to a few per cent; it is estimated that a solution of 25% lithium bromide would have a boiling point, at any given pressure, about 10 deg higher than that of pure water. A more serious effect is that as the water does evaporate the remaining solution becomes more concentrated so that the evaporator temperature continues to rise as the refrigerant flows through the coil.

REFRIGERATOR INSULATION

To ASHRAE:

A Danish manufacturer of refrigerators wishes to know what insulation materials are used in household refrigerators by American manufacturers.

P. K.

Domestic refrigerator and home freezer makers use five primary insulation materials. Glass fibers in various qualities are specified according to individual selection choices. Styrafoam is used for encapsulating the freezer evaporator, for draining and supporting structures between freezer and fresh food compartments and is molded to shapes for fitting in areas that might be difficult to seal completely with other types of insulation. Polyurethane foams are specified as slabs or foamed-in-place after parts have been assembled—as in door assembly. Rigid plastics foam insulation blown with Refrigerant 11 is gaining acceptance because of its low transmission characteristics. Bagged glass fibers are occasionally used for sealing applications where fibers are in contact with surfaces normally below 0 C. This is done here to prevent formation of ice crystals in the insulation. The sealed bags may be evacuated and refilled with gases having heavy molecules and may be heat transmission factors as low or lower than the previously mentioned plastics foams. Wood fibers are in use by one major American manufacturer in the insulation of a lower priced line.

In cabinet assembly operations, it is advisable to seal all joints and seams so that there is no possibility of moisture movement from the ambient air into the refrigerated space of the cabinet. Care should be taken also to prevent any voids in the insulation or areas adjacent to the throat lining or thermal breaker strips between the outer case and inner compartment walls. The clearance between the thermal breaker strips of the door edges and meeting cabinet edges should be at the absolute minimum to prevent heat transmission, by convection air currents, from the outer surfaces to the colder interior in order to prevent sweating around these openings. Many American manufacturers use resistance heaters to raise the temperatures of these surfaces above the ambient dew-point at severe atmospheric conditions. Some manufacturers find it advisable to design and insulate to preclude sweating on exterior surfaces at ambient humidities lower than 85% in 100 F.

TOWARD LARGER CHARTS

To ASHRAE:

Psychrometric charts of large size (good readability) for use in the solution of engineering problems would be helpful to us. The range of dry bulb temperatures involved is from 32 to 500 F, all at 14.696 psia. Also helpful would be a table of dew points, for various absolute humidities encountered in this temperature range.

L. A. K.

Those charts included in the Design Volume of the ASHRAE DATA BOOK cover the widest range of temperature available through the Society. There will be an engineering conference at the ASHRAE national meeting in Dallas, February 1960, which will relate to the engineering requirements of a psychrometric chart, and study of available charts. It is hoped the conference will result in the development of a psychrometric chart acceptable throughout industry.

CEILING FOAM INSULATION

To ASHRAE:

I have just completed a 60 x 30 ft freezer and have run into a problem that remains unsolved. This room has 6 in. of foam insulation throughout. The electrical contractor, instead of stringing his lights under the finished ceiling, bored holes through the wood decking and insulation into the freezer for each of 21 lights. He used a series of two boxes at the decking level then attached a piece of ½-in. metal conduit through the insulation into a box on the underside. Immediately, we ran into a moisture problem. In trying to remedy a bad situation we have gone overhead, into the attic, and poured paraffin into the boxes and conduit to try to seal each fixture, only to find the heat from the lamps melted the paraffin. We know the correct procedure would be to pull out all of the overhead wiring and string it inside the freezer but I am wondering if there might not be a less expensive way to handle the problem?

B. B.

We know of no sealer which could be poured in a semi-liquid form around the lighting fixtures which provide your problem. Perhaps the company that manufactured the insulation may have a suggestion.

True, there are a number of foam plastics insulation materials that might be blown or poured but it is probable that the expense of their installation could scarcely be considered an offset to the difficulties that arise from having metallic conducting items piercing the insulation in freezer rooms.

WHICH CONDENSING SYSTEM?

To ASHRAE:

We operate a chain of 75 supply stores of which almost half are air conditioned by installations ranging from 7½-15 ton, all package units. All but two of the installations are water cooled and our experience with the air cooled units is too scant to provide us with a basis for comparison. We have been told that air cooled equipment requires less maintenance but no one has furnished us with specific figures. Do you know of any study made comparing the costs of operation and maintenance between these two types of package air conditioners?

J. F.

In general, it will be more expensive to install a water cooled system but the operating costs would probably be lower than with air cooled units of identical capacities. There are many variables which must be considered for each specific area before a decision can be reached upon a comparative basis. You will find that the ASHRAE GUIDE AND DATA BOOK provide much tangible information upon which an engineer allied with your staff can base significant studies.

SHRIMP BOATS

To ASHRAE:

Where may I obtain information on the design of marine refrigeration equipment for use on a shrimp boat regarding types, temperatures and humidities which would help in the preservation of de-headed shrimp?

H. L. M.

Information relative to this use of refrigeration equipment may be found in the Applications Volume of the ASHRAE DATA BOOK and articles in REFRIGERATING ENGINEERING. Specific inquiries may be directed to Chairman L. L. Westling of ASHRAE Technical Committee 6.4.

THE THEATER IS IN CUBA

To ASHRAE:

We have a small (550 seat) theater which we operate during the evening and we would like to take advantage of changes in outside air temperature so far as may be practical toward supplying a certain amount of forced ventilation. It is desirable to gain a slight breeze effect over the audience. How many air changes are required for optimum cooling by ventilation? What air distribution systems are designed to provide a breeze effect?

J. D. M.

While there is a considerable amount of information in the ASHRAE GUIDE relative to infiltration and ventilation in theaters and public buildings, it would be impossible to indicate a certain figure which would apply for all locations. We suggest a study of the material in the GUIDE as allied with your specific requirements, but we can cite the following: "Most healthy, sedentary and slightly active men and women, normally clothed and in uniform environments, with air velocities of the order of 25 fpm, are thermally comfortable the year around when the dry-bulb air temperature is in the range of 73 to 77 F and the relative humidity is in the range of 25 to 60 percent." Methods of obtaining desired temperature and humidity levels are many and depend upon your building construction, equipment, installation and physiological requirements within your geographical area.

A STUDENT LOOKS AHEAD

To ASHRAE:

I am a senior engineering student who has an idea with regard to an unusual application for a gas-fired refrigeration system in the 3 to 5 ton range. How can I determine the Btu's required to operate such a system, obtain a thermodynamic flow sheet, define the refrigerants used in a binary system, estimate individual components and their sizing and determine the overall size of the complete package?

E. S.

Reference to the Design Volume of the ASHRAE DATA BOOK, Tenth Edition, Chapter 5 will provide considerable information with regard to absorption refrigeration systems. A copy should be available to you in your university library. As to commercial considerations of sizes and ratings, we suggest that you contact the American Gas Association. However, there is considerable reference material available in our refrigeration and air conditioning library, back issues of many domestic periodicals allied with the field are filed there and the shelves include several hundred textbooks. You are welcome to refer to these sources.

RESTAURANT FOOD TEMPERATURES

To ASHRAE:

We own and operate more than 140 restaurants from coast to coast. Can you send us detailed information regarding suggested refrigeration temperature for preserving all kinds of perishables in restaurants? We wish to prevent spoilage; to preserve the quality and appearance of these perishables; and to ascertain the length of time they can remain properly at these temperatures.

C. G.

Comprehensive information as to the handling, storage and transportation of frozen and refrigerated foods in commercial applications is presented in the ASHRAE DATA BOOK, Applications Volume.

To ASHRAE:

We produce German-made refrigerating plants for ships built for American owners. Is it forbidden to use ammonia as a refrigerant on all American ships or only on passenger ones? Is ammonia forbidden if brine is used for cooling the refrigerating rooms? Is it permissible to use ammonia in cargo ships for direct evaporation? Do the laws apply only to ships under the American flag or also to those run on account of American owners and calling at American ports?

B. E.

Ammonia as a refrigerant on merchant vessels is subject to United States inspection laws and controlled by regulations Subchapter F (Marine Engineering) and Subchapter N (Dangerous Cargo). The latter permits use of ammonia on all vessels (passenger and cargo) in general refrigeration service, direct or indirect systems. However, for air conditioning, ammonia is not allowed except in unit service of the indirect type. The unit system is defined as one assembled and tested prior to installation and installed with refrigerant containing parts completely assembled. An indirect system is one in which the evaporator is used to cool brine or air which in turn removes heat from material or space refrigerated. Regulations in Subchapters F and N apply to all vessels of American Registry subject to the marine inspection laws of the United States. They do not apply to vessels of foreign registry which call at American ports.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES

See page 76, September JOURNAL

REGION AND CHAPTER OFFICERS

See page 76, October JOURNAL

RESEARCH AND TECHNICAL COMMITTEES

See page 84, July JOURNAL

STANDARDS COMMITTEE

See page 79, November JOURNAL

TECHNICAL COMMITTEES

See page 96, May JOURNAL

INTER-SOCIETY COMMITTEES

See page 80, July JOURNAL

Voluntary contributions are important in

Financing ASHRAE Research

It will require $323,200 to conduct the ASHRAE Research Program scheduled for the 1959-60 fiscal year, July 1, 1959, to June 30, 1960. The budget includes funds necessary to maintain a continuing Research Program at the Society's Laboratory and at cooperative universities. It provides for the initiation of new projects, and for the planning of future research.

Laboratory projects will include research in energy transfer through fenestrations, odor control, hot water and steam heating, building infiltration, sound and vibration control and extensive environmental and physiological studies. New Laboratory projects in the fields of control, combustion and refrigeration are anticipated.

Cooperative Research Projects, sponsored by the Society under contractual agreements with universities and institutions, will require $53,900. Nine such agreements are now in effect including research in air cleaning, air distribution, heat losses through ducts, noise in liquid piping systems, sorption, solar energy utilization, refrigeration and thermal circuits. The budget also includes United States Government contracts in the amount of $28,000, with the Laboratory, in the fields of sound and heat measurements. The cost of government projects is met by the agency with which the contracts are made.

Summary of Estimated Research Expenditures

Laboratory	$241,300
Cooperative	53,900
Governmental	28,000
	$323,200



JAMES E. LOUCKS
Assistant Director
Industry Relations
ASHRAE Laboratory

Over and above Government contracts, the Society has but two sources of income for the Research Program. The first is that derived from a portion of the membership dues, the second is from voluntary contributions. A substantial contribution is received from the biennial Heating and Air Conditioning Exposition, held under the auspices of the Society. This contribution is put into reserve and dispensed, as needed, over each intervening two-year period. The budget for 1959-60 uses $52,115 from this reserve fund. Income from membership dues is expected to reach $124,085, leaving a total of $119,000 to be obtained through the receipt of voluntary financial contributions.

Summary of Estimated Research Income

Membership Dues	$124,085
Contributions	119,000
Governmental	28,000
From Reserve	52,115
	$323,200

The preceding summary makes plain the extent to which the Society, in meeting its Research budget, must depend upon contributions. In the ten-year period from 1949 to 1958, an average of 51% of the income for research was derived from contributions received from individuals, companies, corporations and associations. The importance of this generous financial help cannot be over-emphasized.

HELP NEEDED NOW

It is in view of the fact that the benefits of a productive and expanding Research effort can only be realized through industry-wide support that direct contributions to the Research Program must be encouraged and increased. The ASHRAE Research Program is, in every sense, the industry's program as well, therefore, the Society anticipates no difficulty in raising the required funds from the moment that the need for help is known.

The results of Society Research lead to improved conditions for human comfort, health and efficiency and to increased public demand for the services of the profession and the products of the industry. That it may continue to serve and to grow, the Research Program must base its appeal for funds upon universal respect for the quality of its work. On this basis, the profession and the industry have never failed to respond most generously.

Technical Coordinating Committee



JOHN EVERETTS, JR.
Fourth Vice President
ASHRAE

—Research and Technical

—Program

—Publications

—Standards

Section 8.8.4. of the Society's By-Laws states: "The Technical Coordinating Committee shall consist of the Chairman and Vice-Chairman of the Program, Publications, Research and Technical, and Standards Committees, and shall have a Vice-President as Chairman. In addition, there shall be three Members-at-Large appointed by the President of the Society. It shall be the duty of the Committee to coordinate the activities of the Committees named in this Section."

The four Committees named above are responsible for the entire technical phase of the Society.

There are many facets of our technical operations which may be common to more than one of these Committees requiring policy decisions which cannot be made by the Committees themselves and yet are not important enough to be presented at the Executive Committee level except for confirmation and final approval. Any overlapping of services or duplication of duties becomes a waste of time and manpower.

The Technical Coordinating Committee does not control operations, dictate individual Committee policy, nor interfere in any way with Committee personnel or programming of their work. "Coordinating the activities of the Committees" involves only those questions about which the Committees themselves are in doubt.

One example is the question involving a new psychrometric chart for the Society. Should this be a Research project, Program item, Publication problem, or Standard study? The answer is that it belongs to all four Committees and the Technical Coordinating Committee delegated the problem as follows:

1—The Research and Technical Committee to investigate the existing chart and tables for technical accuracy.

2—The Program Committee to hold a conference on the subject at a National meeting.

3—The Publications Committee to develop a format and size (or sizes) to be published.

4—The Standards Committee to set up a standard for the chart and table.

In this particular instance, each Committee has been given an assignment within the scope of its operations and upon completion of the individual assignments of the four Committees, a unified recommendation will be presented to the Board of Directors for approval.

Questions also arise as to whether the results of a Research project should be presented as a paper; included in a conference or symposium; or published only as a research bulletin. The results may also indicate the necessity for adapting a new standard or modifying an existing one. There is no clear-cut line of demarcation to tell whether many of these questions can be shunted directly to any one of the Committees without somehow involving one or more other Committees. A thorough discussion by the members of the Technical Coordinating Committee is the simplest way to resolve this problem to the best interests of the Society and its members.

As the Society expands its operations, the problems will become more complex and the stature and importance of this Committee will also grow. There is no doubt that this Committee, operating as intended, will enable the technical phases of the Society to operate more smoothly and efficiently resulting in a better understanding and better service to the membership.

Apple storage improved

by controlled atmosphere system



J. W. ZAHRADNIK

Key to the controlled atmosphere process is maintaining a temperature of 37 F (±1½ F); a relative humidity of 85-90 %; and an atmosphere of 3 % oxygen (O_2), 5 % carbon dioxide (CO_2), and 92 % nitrogen (N_2) and miscellaneous inert gases. These storage conditions make it possible to preserve the quality of McIntosh apples for 6 to 8 months on a commercial basis.

After a controlled atmosphere storage is properly loaded and sealed, the atmosphere composition is 17-21 % O_2 and 79-83 % N_2 and miscellaneous inert gases. Exact composition will depend on the amount of air exchange during loading. The Orsat apparatus is commonly used to determine atmosphere composition. This initial atmospheric composition must be modified to 3 % O_2, 5 % CO_2 and 92 % N_2 through proper manipulation of the materials balance.

The apples continue respiring which requires O_2 and produces CO_2 simultaneously. Thus, there is a reduction in O_2 level and an increase in CO_2 level. This is illustrated in Fig. 1. As this respiration continues the CO_2 level will reach 5 %, one of the controlled conditions. Until this point is reached, in a relatively gas tight storage, the total materials balance has not been disturbed volumetrically; the materials have been changed in composition only. However, as respiration continues, the CO_2 level will rise above 5 % and it is at this condition that CO_2 is removed by scrubbing the atmosphere with sodium hydroxide solution and the materials balance on a volumetric basis must be maintained by the addition of N_2. In this way the CO_2 level is held relatively constant, the apples continue to bring down the O_2 level, and the materials balance is further maintained by the addition of N_2 until final process conditions are reached. These various atmosphere conditions are illustrated in Fig. 2.

When final process conditions are achieved, (after from 10-20 days of storage), air must be added to maintain the materials balance instead of N_2, since the apples continue to respire (although at a much reduced rate), and require the O_2 present in air. The addition of air to maintain 3 % O_2 and the scrubbing of CO_2 to maintain 5 % continues throughout the storage season. These storage conditions are maintained at present by manual control, with some electric time clock programming of the CO_2 scrubber operation.

Equipment necessary to maintain process conditions is illustrated schematically in the diagram of Fig. 3. The purpose of each piece of specialized equipment is summarized in the table which accompanies Fig. 3. The identification numbers are keyed thereto.

STRUCTURES FOR CONTROLLED ATMOSPHERE

Critical factors to be considered in a structure for controlled atmosphere are: Size, insulation, vapor barriers, gas seals and gross gas permeance tests prior to loading with apples. The relationship between capacity and length, width, and height is shown in Fig. 4. These dimensions are based on an allowance of 2.5 cu ft/p/box of apples and do not consider building or pallet modules.

Good practice in the use of insulation, vapor barriers, and gas seals is illustrated in the typical floor, wall, and ceiling sections of Fig. 5. It should be noted that insulation requirements are specified in terms of U, the overall coefficient of heat transfer. A rapid means of comparing thicknesses of insulations of different thermal con-

Extension of the storage life of apples was made possible by F. Kidd and C. West during the late 1920's and the early 1930's when they developed the controlled atmosphere process for this purpose. The first commercial controlled atmosphere storages for McIntosh apples were built in New York in the early 1940's. During the 1940's total capacity in New York rose quite gradually to about 100,000 boxes. Since 1950, however, growth of controlled atmosphere capacity has increased more than tenfold in the Northeast. In Massachusetts, controlled atmosphere storage capacity has grown from 7,000 boxes in 1952 to more than 440,000 boxes in 1958.

J. W. Zahradnik is Associate Research Professor, Agricultural Engineering Dept., University of Massachusetts. This paper, presented at the Connecticut Valley Sect of ASRE, February, 1959, also presented at the ASHRAE annual meeting in Lake Placid, N. Y., June 22-24, 1959, is authorized for publication as Contribution 1196 of the University of Massachusetts, College of Agriculture and Massachusetts Experiment Station. This is a condensed version; the full text of "Controlled Atmosphere Apple Storage Process and its Requirements on Refrigeration Structures and Systems" will be published in ASHRAE Transactions.

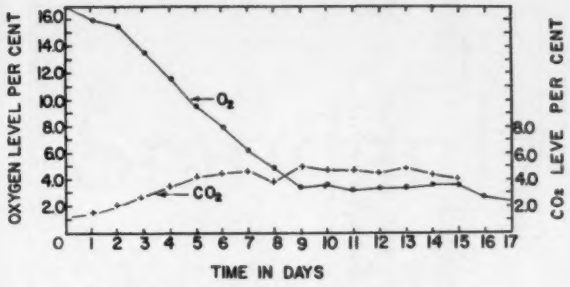


Fig. 1 Time vs. oxygen level

Fig. 2 The controlled atmosphere process

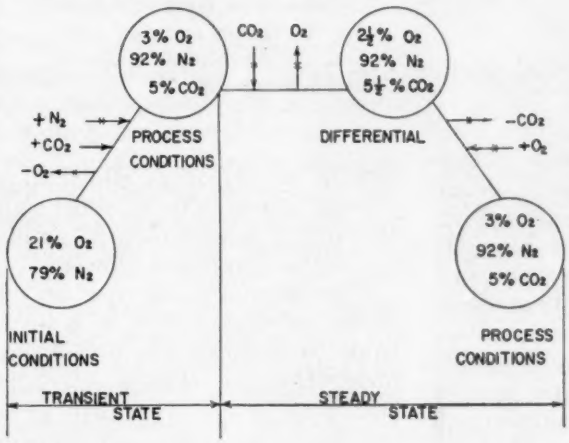
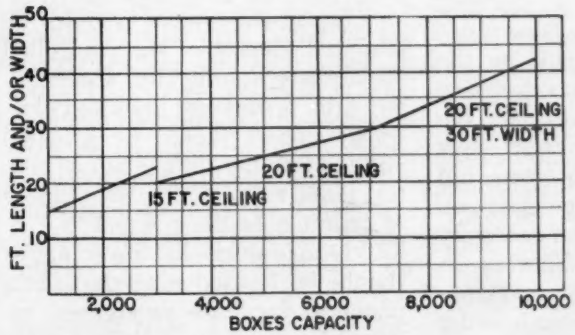


Fig. 4 Relationship between capacity and physical dimensions



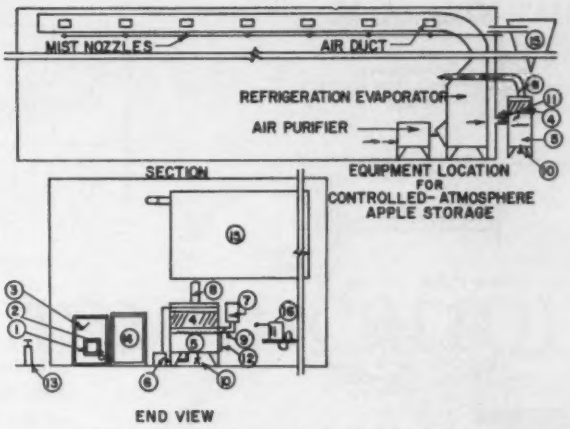


Fig. 3 Equipment location for the controlled atmosphere apple storage

Identification No.	Name	Function
1	Access panel	To permit emergency entry for minor repairs and inspection.
2	Porthole	To permit withdrawal of fruit samples during storage season.
3	U safety trap	To prevent build up of excessive internal pressure or vacuum
4	Coke packing	To provide surface area for contact between the CO_2 of atmosphere with the sodium hydroxide of the scrubber.
5	Sump	To provide storage for the sodium hydroxide solution of the scrubber.
6	Circulating pump	To pump the sodium hydroxide solution from the scrubber sump to the coke packing.
7	Mixing bucket	To provide a container for dissolving the sodium hydroxide flakes into water.
8	Blower	To circulate the storage room atmosphere through the CO_2 scrubber.
9	Valve	To fill the scrubber sump.
10	Valve	To drain the scrubber sump.
11	Wet and dry bulb thermometer	To determine relative humidity.
12	Sight glass	To determine the level of the sodium hydroxide solution in the scrubber sump.
13	Nitrogen tank	To maintain the materials balance during the initial O_2 come down.
14	Door	To provide insulation over the gas tight seal.
15	Breather bag	To equalize pressure differentials due to temperature fluctuations and minor disturbances to the materials balance.
16	Orsat apparatus	To determine the atmosphere composition.

ductivities, K, to achieve equivalent U values is presented in Fig. 6.

Gross gas permeance tests after completion of the construction are the best assurance of the satisfactory performance of a controlled atmosphere storage. Gross permeance data can be used to compute a materials balance which will indicate whether or not O_2 leakage into the storage is at a rate in excess of what the apples require. If the leakage rate is in excess of the respiration requirement, then the 3% O_2 level cannot be maintained. An example of two gross permeance tests, as discussed here, is shown in Fig. 7.

The commonly used test for adequacy of the gas seal is the pressure relaxation tests. The room is sealed and the pressure inside raised to 1-in. water gage by means of a small centrifugal fan. The pressure drop after the fan is shut off and the port closed is recorded at time intervals of 3 to 5 min. If 0.1-in. water gage remains after 25 min, the room in most cases is tight enough. This is a rule of thumb and has been widely used for several years. The pressure relaxation curve reproduced as Fig. 8 indicates the pressure-time relationship as expressed in inches of material minutes.

REFRIGERATION SYSTEMS FOR CONTROLLED ATMOSPHERE

Refrigeration systems for the controlled atmosphere apple storage process should provide adequate cooling capacity. The relationships between refrigeration capacity and the various heat loads are shown in Figs. 9 and 10.

The above relationships were developed on the basis of the specifications for wall, ceiling, and floor sections and geometric con-

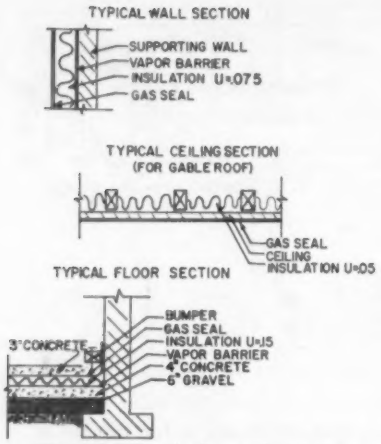


Fig. 5 Typical sections for controlled atmosphere storages

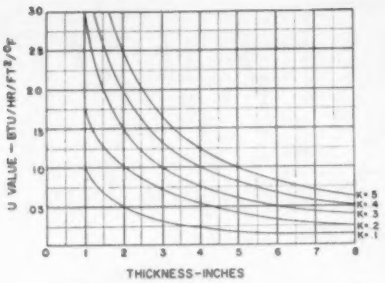


Fig. 6 Thicknesss vs. coefficient of heat transfer for insulation with conductivity from 0.1 to 0.5 Btu/hr/ft²/F in thickness

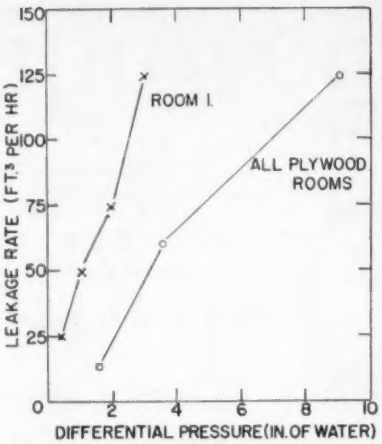
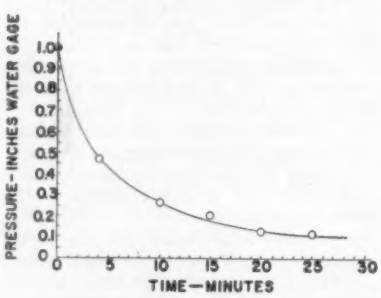


Fig. 7 Graph showing relation of differential pressure and leakage rate

Fig. 8 Controlled atmosphere storage pressure-relaxation test



figuration of the structure presented in this paper in the section on "Structures for Controlled Atmosphere." Sensible heat removal is based on cooling from 80 to 32 F in 24 hrs. It should be noted that while controlled atmosphere process conditions call for an operating temperature of 37 F, current good operation practice requires cooling during loading to 32 F. After sealing the controlled atmosphere room, the temperature is allowed to rise to 37 F.

In addition to adequate cooling capacity, refrigeration systems for controlled atmosphere should meet several other requirements. A reasonable amount of humidity control should be assured by provision of sufficient evaporator surface at the dew point temperature (33 F for 85% relative humidity and 37 F dry bulb). Mist nozzles can be used to correct certain small deficiencies in humidity control due to inadequate evaporator surface areas and temperatures.

While high air velocities are desirable during initial cooling, these high air velocities later result in unnecessary heat loads on the storage and in some cases excessive infiltration of outside air into the storage due to the aspirator effect of high velocities across any pin hole leaks in the storage gas seal. In some cases it has been necessary to install two speed blowers on evaporators or to operate evaporator blowers only part time in order to prevent excessive infiltration of outside air. Duct air distribution systems appear to be more dependable in this respect than do simple free air discharges on blowers.

To minimize the risk of off flavors or tainted fruit, it is justifiable to eliminate the use of any toxic refrigerant. This is especially hazardous considering that as a rule controlled atmosphere storages are completely sealed for at least 5 months and a small refrigerant leak in the evaporator could go unnoticed for some time.

Expansion valves should be mounted outside of the controlled atmosphere storage for accessibility. Also, refrigerant lines and electrical conduit should be grouped and fed into the storage at one central point to minimize the number of openings in the gas seal.

Evaporators and blower motors should be located near the access panel to facilitate emergency repairs. In some cases, these repairs can be made without loss of the storage atmosphere.

Fig. 9 Loading rate vs. sensible heat and respiration heat load

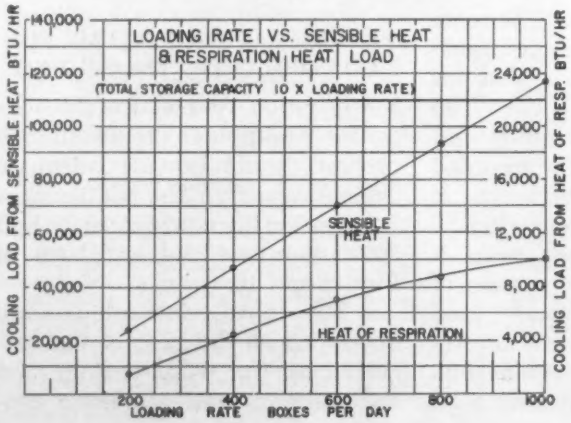
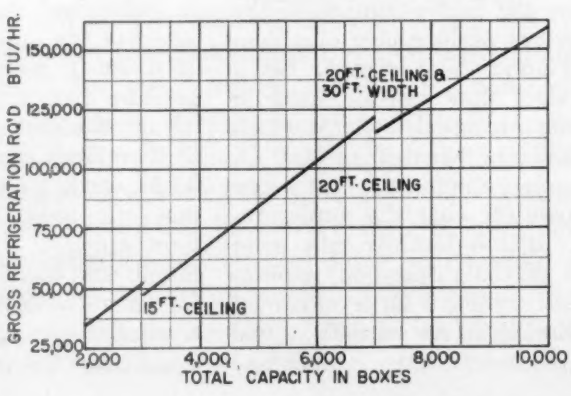


Fig. 10 Total capacity vs. gross refrigeration required



Standards through communication

A. T. BOGGS, III
ASHRAE Technical Secretary

"Technical societies have unique facilities for drafting national standards because they have an already-established communications system that provides a direct means of finding qualified people and provides a clearing point for collected information." This comment was made by C. L. Fanning, vice-chairman, National Standards Committee, American Society of Tool Engineers. Mr. Fanning spoke at the Tenth National Conference on Standards sponsored by ASA.

In ASHRAE the communications system that develops standards, technical papers, material for use in the GUIDE and DATA BOOKS, and general answers to technical inquiries is based on the comprehensive committee set-up which has been developed by your national committees. Considering such an arrangement as a communications system will enable the individual member to better appreciate the purpose of such committees.

Standardization Survey: ASA has announced the publication of a report of a survey conducted on the organization, costs, and savings of standardization activities in American industry. This was accomplished through a comprehensive questionnaire survey. There were 238 company replies analyzed and it was found that more than 200 conducted some kind of standards activities. Approximately 15 per cent of these companies reported specific dollar savings through the use of standards. There was a definite indication that a close link exists between organized standards work and recorded cost savings. ASA points out, however, that the report also indicates a majority of American companies does not fully realize the potential cost savings through standardization. Copies of this report may be purchased from ASA at 50c each for members and $1 each for non-members.

Electrical Code: A recent release indicates that a revision of the national electrical code has been approved by ASA. It is being published by NFPA and in a pocket edition by NBFU. The 1959 edition of the NEC includes a considerable number of changes from the 1956 edition. To assist users of the Code in comparing the 1956 and 1959 editions, an analysis of the changes has been prepared by Nema. Copies of the analysis are available at 50c each from National Electrical Manufacturers Association.

Definitions: The use of such words as, specification, standardization, code, or procedure by industry groups has not been consistent. This problem has led to a number of articles by prominent standards engineers. The following definitions appeared in Magazine of Standards, October 1959:

Specification—A specification is a concise statement of the requirements for a material, process, method, procedure, or service, including, whenever possible, the exact procedure by which it can be determined that the conditions are met within the tolerances specified in the statement. A specification does not have to cover specifically recurring subjects or objects of wide use, or even existing subjects.

Standard—A standard is a specification accepted by recognized authority as the most practical and appropriate current solution of a recurring problem.

The standards developed by ASHRAE are methods or procedures of testing specific types of equipment or components. According to the above definitions, a concise statement of the requirements for a method or procedure is a specification. Since the methods of test developed by ASHRAE are adopted (accepted) by the membership (recognized authority), they comply with the above definition of a standard. The development of simple definitions as above should be of assistance to those actively concerned with the development or use of industry standards.

Exhaust Standards: The ASA Z9 Sectional Committee has recently completed letter ballot action on a draft of the American Standard "Fundamentals Covering the Design and Operation of Local Exhaust Systems." In addition to ASHRAE, this standard is co-sponsored by AMCA and AIHA. This revision to an earlier standard will be available in the near future and notice will be made in this page.

. . . 15 per cent reported specific dollar savings through the use of standards

. . . National Electrical Code in a pocket edition

. . . Standards developed by ASHRAE are methods of testing specific types of equipment or components

ARI Atlantic City Show

was the 11th in a series

Preceded and paralleled by several meetings of various industry groups, the 11th Exposition of the Air Conditioning and Refrigeration Industry was held in Atlantic City at Convention Hall, November 2-5. There were a few less than 200 exhibitors displaying an estimated $5 million of equipment ranging from complete units and large component assemblies to small parts and accessories.

It was a colorful affair in which some elaborate and extensive displays closely allied with the product fields involved vied with smaller exhibits of somewhat extraneous character. Indeed, most evidently popular centers of attention were the separate displays of nine or ten 1960 American automobiles featuring factory-installed air conditioning. Their hoods open, visitors pored over them in rings several deep; displaying quite as much interest in the cars themselves as in the designed-in facilities for environmental comfort.

INDUSTRY MEETINGS, TOO

The Refrigeration Service Engineers Society met October 30-November 2 at the Ambassador Hotel; their sessions highlighted by eleven industry speakers who discussed not only servicing problems but recent technical advances. These included a discussion of progress in hydronic heating and cooling by J. W. Hall of National-U. S. Radiator, of developments in automotive air conditioning by Willis Stafford of American-Standard, of oil migration in Refrigerant 12 and Refrigerant 22 Systems by Norman Sharpe of California State Polytechnic College, of design, application, installation and servicing of large compressors with mechanical unloaders by M. M. Lawler of the Worthington Corporation and of the history and potentialities of thermoelectric refrigeration by Royal S. Buchanan of the Westinghouse Electric Corporation.

The Air Conditioning and Refrigeration Wholesalers were at the Shelburne November 1-2 for their annual meeting. Sales and promotion factors were emphasized at several sessions.

The National Commercial Refrigerator Sales Association had headquarters at the Traymore, November 2-3, and speakers reviewed various considerations allied with sales promotion, product distribution, assistance to small stores and other functions allied with distribution problems.

ARI CONFERENCE

Show sponsor, Air Conditioning and Refrigeration Institute, held its annual meeting at Haddon Hall on November 1 but presented a four-speaker conference on November 2 on the stage of Convention Hall. More than 200 attended this feature, new to ARI shows, and heard discussions of quick frozen foods, residential air conditioning, commercial air conditioning and allied problems of national defense as related to cooling functions.

Marking the progress in quick-frozen foods, Harold J. Humphrey, president of the National Association of Frozen Food Packers, called attention to the 2400 railroad cars and 34,000 trucks presently equipped to maintain temperatures of 0 F or lower, to the 11½ million domestic freezers now in use and to the 4½ million frozen food lockers available to individuals. He also called attention to the need for new refrigerators capable of maintaining 0 F or lower, considering not more than one half now in use to be suitable for this level of performance. Speaker Humphrey foretold prepared foods as the spectacular of the industry, there having been a 20 to 25% increase in 1959 over 1958.

With the theme of "How Many of Us Are Planning for Tomorrow as though Tomorrow Were Yesterday?" A. S. Goldman of House and Home predicted that 1960 would be the beginning of the breakthrough for air conditioning as the number one sales feature of the residential home market.

Speaking of developments in the air conditioning and refrigeration of shopping centers, Herman Guttman, Consulting Engineer, cited conspicuously the Southland-Dayton-Minneapolis development where cooling—not heating—is required at outside temperatures as low as —20 F when light, power and people loads are equated and balanced. The speaker urged overall planning for such developments in the interests of full economy rather than having individual operations waste Btu's in a one-shot, do-it-yourself setup.

T. R. Casberg, Mechanical Engineer in Charge of Air Conditioning in the office of the Assistant Secretary of Defense for properties and installations, reviewed such projects as the air conditioning of nuclear powered submarines, of missiles and of supersonic planes. This discussion accompanied an elaborate exhibit by the Government at the ARI Show where specific units of equipment were displayed and accompanied by tangible descriptive poster material of both general and specific informational value.

BEHIND THE SCENES

Alert observers found a Show up to the usual high standards of its ARI predecessors, somewhat less fully participated in as to both exhibits and visitors, and one where interest in the individual displays was clearly evident. The attitude

of those who attended was significantly more than casual.

There were those who commented upon the multiplicity of recent industry shows, this year and next, and offered conjectures upon the influence of the merger-necessitated dropping of the formerly proposed ASRE Semiannual Meeting for Atlantic City, to have been coincident with this Exposition. The corresponding Semiannual Meeting of merger-formed ASHRAE is being held February 1-4 in Dallas, Texas.

Overall, it was clear that those active in the fields of air conditioning and refrigeration were disposed to feel that 1959 had been a year of highly satisfactory volume sales and of profits, too. It was a consensus that 1960 held even higher hopes. There were few who felt that engineering, product development or equipment production problems were dominant at this time, the emphasis being rather upon selling that which had already achieved reality. Yet, clearly, the potentialities of such newer things as thermoelectric heating and cooling were far from lost for consideration.

Valence-wall research

voted by IBR at semiannual meeting

Unanimous approval of a motion authorizing a research project at the I-B-R Home upon the valence-wall development of the Pierce Foundation was voted at the Semiannual Meeting of the Institute of Boiler and Radiator Manufacturers at the Seaview Club, Absecon, N.J., November 10-12. Much discussion preceded the formal approval and the motion, as carried, called for the appointment of a special committee to discuss those licensing terms upon which the Foundation would permit the use by manufacturers of the basic valence-wall principle.

AT THE I-B-R HOME

Preceding formal authorization of this new project Professor Warren Harris of the University of Illinois reported in considerable detail at the Wednesday session upon the work thus far done with a new I-B-R Home near the University campus. This newest Home is of tri-level construction and initial research consisted in determining customary factors for each of the separate levels, these having been isolated for the purpose of the investigation. A subsequent report will integrate factors for the entire home with the stratifying barriers removed.

Professor Harris reported that two pamphlets regarding research to date were off the press but had not yet been distributed. A feature of this most recent I-B-R Research House is the open-wall construction which permits changes in insulation media and levels in the investigation of hydronic facilities for heating and cooling. In the authorized research upon valence-wall, comparisons will be made with other methods of heating and cooling as well as definitive exploration of the essence of the newer project.

Preoccupation with problems arising from the use and abuse of IBR emblems and ratings produced recommendations by General Manager R. E. Ferry for specific steps to preclude misuse. The same speaker, referring to the gathering, confidential handling and constructive use of statistics as derived from IBR members urged the complete cooperation of all to strengthen this industry service upon the plane of full inclusiveness and prompt reporting.

FABRICATING FUNCTIONS

Again, under the prompting of Chairman M. C. Reed there was a round table discussion of the merits of manufacturing committees. It was pointed out that the pooled knowledge, plant trips and exchange of information as well as wage data were highly constructive within the IBR pattern and have so proved themselves over the years. An extension of the activities to specific fabricating functions was proposed and accepted for future development.

During this meeting a serious attempt to fathom the future, specifically 1960, in terms of volume of business to be derived, competitive factors to be encountered and similar related factors, was undertaken. It was the consensus of the primarily sales-minded group that 1960 would be a good year for the members of this Institute but that it would require an intensification of efforts over and beyond those evident in 1959 and that some newly cultivated resourcefulness would be essential also.

Next Month——

Preview of ASHRAE Semiannual Meeting to be held in Dallas, Texas February 1-4.

- **Program**
- **Abstracts of Technical Session Papers**
- **Summaries of Conference and Symposium Papers**
- **Floor Plan and List of Exhibitors for 2nd Southwest Heating and Air-Conditioning Exposition**

Nominations

for election of ASHRAE Board of Directors

The following nominations for vacancies upon the ASHRAE Board of Directors have been made by a Nominating Committee as specified in the By-laws of the Society and Agreement for Consolidation. The Committee, whose Chairman is P. B. Gordon, and with representation by Leon Buehler, Jr., as a member of the last prior Nominating Committee, consisted of S. F. Gilman (Region I), G. C. Davis (Region II), W. A. Siegfried (Region III), R. K. Rouse (Region IV), L. C. Burkes (Region V), D. S. Falk (Region VI), D. M. Mills (Region VII), G. H. Meffert (Region VIII), J. K. James (Region IX), and R. M. Westcott (Region X) and these selections by the Board of Directors: R. A. Baker, J. R. Caulk, Jr., H. G. Murray, P. N. Vinther, R. A. Sherman and B. W. Farnes.

FOR TREASURER, JANUARY 1960 – JUNE 1960: F. Y. CARTER



Long active in the field of refrigeration, his major interests lie in the area of expansion valves, with several papers published in various technical magazines. A well-known lecturer on the subject of valves and their effects on refrigeration systems, he has often addressed ASRE national meetings.

Awarded a B.S. in mechanical engineering from the University of Kentucky's College of Engineering, the Treasurer-nominee has studied also at the University of Michigan and Wayne University. Recently appointed Manager, Market Planning, Detroit Controls Div of American-Standard, he had previously been Research Engineer at Detroit Lubricator Company.

Currently First Treasurer ASHRAE, he served as Second Treasurer following the merger, and as Treasurer of the former ASRE prior to this. He has, in addition, acted as Chairman and Vice Chairman of the ASRE Program Committee, member of the General Technical Committee, alternate on the Nominating Committee and Section Director for Detroit (term ending June 1953).

FOR DIRECTORS:
REGION I, JANUARY 1960 – JUNE 1961: WALTER HEYWOOD

Long associated with the firm of Henri B. van Zelm & Associates as a consulting engineer, has been involved with the fields of heating, ventilating and air conditioning since 1925. Work on such projects as Pratt & Whitney Aircraft Company, New London Submarine Base, Southern New England Telephone Company and Hartford Gas Company, among many others, has included design and writing of specifications.

REGION II, JANUARY 1960 – JUNE 1961: DONALD L. ANGUS

Retaining the Vice Presidency of H. H. Angus & Associates, Ltd., Toronto, founded in 1952, he was previously President of Angus, Butler & Associates. An ASHAE member since 1946 and graduate of the University of Toronto (1941), he has authored numerous articles for various publications.

Society activities include, on the national scene, membership (1956-57) on the Nominating Committee, and, locally, Presidency of the Ontario Chapter (1955-56) and membership on its Board of Governors (1951-58). In addition to ASHRAE affiliation, he has served on the Council of the Association of Professional Engineers of Ontario.

REGION III, JANUARY 1960 – JUNE 1961: EARLE K. WAGNER



Affiliation with the Philadelphia Chapter included holding offices of Secretary in 1947 and President in 1952.

National activities were membership on the Committee on Honors for Engineers, Chapters Conference, Chapters Regional, Nominating and Public Relations Committees, serving as Chairman of the last.

REGION IV, JANUARY 1960 – JUNE 1962: J. G. WOODROOF



Associated with the Georgia Experiment Station, has been head, Dept of Food Processing since 1938. He is affiliated with the Georgia Section of the former ASRE, serving as Vice Chairman in 1940 and Chairman in 1941, and is currently Director of Region IV of ASHRAE.

A member of Council since 1948,

he has served as Chairman, Research-Nominating Committee, 1955-56, and member of the Research Committee in 1954 and the Technical Committee in 1950-53. Author of numerous papers published in Refrigerating Engineering, he has spoken at several ASRE national meetings. Listed in American Men of Science since 1940, he was author of Chapter 22 of the Data Book, Chapter 22 of the 5th Applications Volume and Chapter 23 of the 4th Applications Volume, and Associate Editor of Section Two of the last.

REGION V, JANUARY 1960 – JUNE 1962: JAMES H. DOWNS



Educated at University of Cincinnati's College of Engineering and Commerce and YMCA College, Dayton, Ohio, has been associated, at different times, with Frigidaire, Norge Div of Borg-Warner Corporation and Hotpoint Company.

Activities in the former ASRE were as Chairman, Western Michigan Section, in 1950 and member of the Publications Committee.

REGION VI, JANUARY 1960 – JUNE 1962: L. K. WARRICK



Former member of ASRE Council, representing Cleveland Section as Director, 1947-49, 1952-55, served as Cleveland Section Vice Chairman and Chairman. His national activities have included service on the Admissions and Membership Committees. President of the Refrigeration Service Engineers Society, 1935-36.

President of Refrigeration Supplies, Inc., a company he founded in 1936.

REGION IX, JANUARY 1960 – JUNE 1962: FRED JANSSEN

Former member of ASHAE Council, served as Region III Director and continued as Director of the same area in the new Region IX, ASHRAE. Upon joining the Society in 1945, he became an active member of the Rocky Mountain Chapter, as Secretary in 1945-46; President, 1948-49; a member of the Board of Governors, 1945-51; Chairman of the Code Committee, 1950-58; and Chapter Representative to the Colorado Engineering Council, 1950-54. Nationally, he has been a member of the Nominating, Program, Standards and Membership Committees.

Presently Standards Engineer for the Gas Dept of Public Service Company of Colorado, he has been with the organization since 1928.



FOR DIRECTORS AT LARGE:

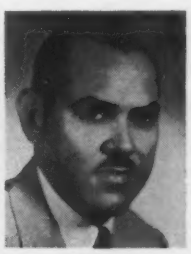
JANUARY 1960 – JUNE 1961: JOHN H. FOX



Treasurer of ASHAE in 1958, served on the Council from 1951-56 and was Region VII Director in 1956. A member of the Board of Governors of Ontario Chapter 1938-39 and 1946-48, he was Chapter Vice President in 1949 and President in 1950.

National activities have been on the following committees: Chapter Delegates, 1949; Chapters Conference, 1950 and 1952; Chapter Relations, 1950, 1955; and Membership, 1954.

JANUARY 1960 – JUNE 1962: G. A. LINSKIE



Member of the former ASHAE since 1939, active both locally and nationally, and President of his own company since 1950. He has meen President, Vice President, Secretary-Treasurer, member of the Board of Governors, and Chapter Delegate of the North Texas Chapter; Chairman of the Resolutions Committee; and member of the ASHAE-AIA Committee on Cooperation, Nominating Committee, and Subcommittee on Programs and Papers.

JANUARY 1960 – JUNE 1962: JOHN W. CHANDLER

Active in several organizations other than ASHRAE, includes in his affiliations Mechanical Contractors Association of America, U. S. Naval Institute, Naval Engineers, American Society of Naval Architects and Marine Engineers and Washington Building Congress. He is currently Branch Manager with York Corporation.

Member of the National Capital Chapter, he has been Chairman of the Membership, Program and Outing Committees, Vice Chairman (1951-52) and Chairman (1952-53). A former member of ASHAE Council, he was Region III Director (1956-59) and a member of the Marine Subcommittee.

In order to comply strictly with the provisions of the By-laws, a Special Nominating Committee has made the exact same nominations for each of the offices above named and said petition has been filed with the Executive Secretary as required by Section 8.8.18, and is open to the inspection of any voting member.

December 1, 1959 **R. C. Cross, Executive Secretary**

What ASHRAE Chapters are doing

Industrial use of atomic energy was featured at several meetings, while other groups covered subjects ranging from gas turbines to plastics insulation. Regional meetings highlighted the new season, as local chapters played host to regional membership and guests.

SIX CHAPTERS REGIONAL COMMITTEE MEETINGS, attended by official delegates and alternates of more than 50 ASHRAE Chapters throughout the northeast, southeast and middle west, and representing 27 states, were held during October. These were the first regional gatherings for representatives of more than half of the chapters in the Society since the merger, the four remaining regions having held their Chapters Regional Committee Meetings during the spring of this year.

Featured at all of the meetings were discussions between the officers, regional directors, delegates and headquarters on many items arising from the merger. Chapter progress, model by-laws, and other matters having to do with improved operations of the Society and the chapters, including publications, dues structure, meeting programs, speakers and membership were discussed. Special discussions regarding the new United Engineering Center and the fund raising campaign were led by Society officers at all the meetings and photographs and publications related to the UEC were on display.

Guests, delegates, alternates and host chapter members at the Region I Meeting heard Dr. Walter R. Dornberger, Director of Engineering of Bell Aircraft Corporation's Niagara Frontier Div, discuss "Utilization of Space," and were then taken on a tour of Niagara Falls and the Niagara Power Project.

At a technical session accompanying this meeting, papers were presented as follows: "Applications of Thermoelectricity," R. G. Sickert, Research Engineer, Whirlpool Corporation; "Research Program of Our Society," Burgess H. Jennings, Director of Research, ASHRAE; and "High Temperature Hot Water Heating," Alex Kuli, Plant Engineer, Dunlop Tire and Rubber Company.

As host to Region III membership and guests at the October 21st meeting, Baltimore Chapter presented a full program, consisting of a tour of Baltimore Aircoil Company in Jessup, Md., and addresses by two speakers, ASHRAE President Arthur J. Hess and Robert C. Deitrich, Building Inspection Engineer of Baltimore.

President Hess spoke on "Titles Don't Make Engineers", during which he stressed the importance of work and ethics over titles. Speaking further, he emphasized the need for cooperation between the owner, architect and engineer when planning an air conditioning system for a new building. Owners must, he declared, be made to realize the value of having a complete system installed, while architects



October 14th saw Region V delegates and guests converging on Dayton, Ohio, where the Chapters Regional Committee Meeting was held. In attendance were (front row): D. G. Ely, Dayton Chapter Treasurer; J. W. Snyder, Director-at-Large; F. W. Hofmann, ASHRAE Assistant Secretary; ASHRAE President A. J. Hess; R. A. Tull, ASHRAE 3rd Vice President; T. G. Crider, Regional Director; F. H. Doench, Dayton Chapter Secretary; N. O. Mitchell, Dayton Chapter President; and (rear row): C. W. Couch, Cincinnati Chapter; R. E. Deaux and R. E. Ahlf of Evansville Chapter; W. F. Freije, Central Indiana Chapter; J. L. Frisse and R. M. Hepner of Cleveland Chapter; J. F. Guest, Toledo Chapter; J. G. Thornburgh, Central Indiana Chapter; R. C. Liebert, Columbus Chapter; T. A. Lutz and T. R. Lienesch of Dayton Chapter

should furnish the engineer with the needed space for such a system.

Common to all municipalities are the problems of building inspection, multiple dwelling units and public building safety and health regulating codes. Speaking on this broad subject, Robert G. Deitrich explained the purpose and aims of and benefit to the community from his job as Building Inspection Engineer.

Guests at the Region VI Meeting held on October 12th in Chicago, were ASHRAE President Arthur J. Hess and Assistant Secretary F. W. Hofmann. In a brief speech, President Hess brought delegates up-to-date on the progress of the merger in the areas of membership and publications.

Tracing the history of submarine construction, E. H. Honegger of the Navy's Bureau of Ships, Refrigeration Section, main speaker of the evening, lectured on "Atomic Submarine Air Conditioning and Refrigeration." Pointing out the close tie and the essential nature of air conditioning in the operational capabilities of the ships, he illustrated the equipment layout in the new Polaris project submarines. Mr. Honegger described the Navy's experience with reciprocating, absorption and centrifugal machines and explained the special problems of noise suppression, manufacturing an atmosphere and elimination of the carbon dioxide, carbon monoxide and other foul gases during extended periods of submersion.

GOLDEN GATE . . . "Nuclear Energy for Industrial Heat" was introduced to members at their first meeting of the 1959-1960 season by Prof. Lawrence M. Grossman of the Nuclear Engineering Dept of the University of California. Covering the non-power uses of nuclear reactors for process heat and space heating applications, Prof. Grossman described a projected nuclear heating station to be built by the Swedish State Power Board for house heating near Stockholm.

EVANSVILLE . . . Indiana will have 25,000 electrically heated homes by 1965, A. B. Conant, a partner of Couchman-Conant, Inc., predicted at this group's October meeting. Mr. Conant, whose subject was "The Past, Present and Future of the Electrical Heating Industry," reviewed the history of this method from the early 1800's, through the introduction of incandescent lighting, World War I, and its increasing growth in this century. Churches, schools and commercial buildings are, he declared, an important electric heating market.

SOUTHERN CALIFORNIA . . . Tracing the evolution of windows in structures from medieval castles to modern glass wall buildings, Patrick Kelly, Building Manager of California Savings and Loan Association, asserted that designers of modern edifices neglected to take into account the power of the sun when they used so much glass. Primary concern, according to the speaker, is with the sun's electromagnetic energy waves, which pass through the glass, changing into long wavelength sensible heat that is trapped inside the building.

With a double duct system and 200 ton of refrigeration, the California Savings and Loan Association Building is able to maintain an inside temperature of 74 F with an outside air temperature of 110 F in summer. In winter, however, with a 56 F

(*Continued on page* 84)



Region VI delegates were guests of the Illinois Chapter on October 12th, when the Chapters Regional Committee Meeting was held in Chicago. Here gathered are (rear row): D. S. Falk, C. J. Henstrock, J. B. Olivieri and M. O. Wehmeyer of Michigan Chapter; John Illingworth, Wisconsin Chapter; W. Hessels, Western Michigan Chapter; Robert Demange and E. O. Hull of Illinois-Iowa Chapter; D. A. Rackliffe, Western Michigan Chapter; R. S. Stover, Iowa Chapter; J. Scott, G. R. Carlstrand, L. K. Warrick and E. P. Heckel, Jr. of Illinois Chapter; and (front row): L. Smith, Central Michigan Chapter; R. O. Hardwick, Wisconsin Chapter; F. W. Hofmann, ASHRAE Assistant Secretary; P. J. Marschall, Regional Director; J. W. Hall, Illinois Chapter; R. G. Gridley and T. D. Merchant, Minnesota Chapter

Meetings ahead

December 3-4 – National Warm Air Heating and Air Conditioning Association, Annual Convention, St. Louis, Mo.

December 26-31 – American Association for the Advancement of Science, Annual Meeting, Chicago, Ill.

February 1-4 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Semiannual Meeting, Dallas, Tex.

February 1-4–2nd Southwest Heating and Air-Conditioning Exposition, Dallas, Tex.

March 6-10 – National Association of Frozen Food Packers, 19th Annual Meeting, Chicago, Ill.

March 21-23–First National Electric House Heating Exposition, National Electrical Manufacturers Association, Electric House Heating Equipment Sect., Chicago, Ill.

March 29-31 – American Power Conference, 22nd Annual Meeting, Chicago, Ill.

March 30 - April 1 – Gas Appliance Manufacturers Association, Annual Meeting, White Sulphur Springs, W. Va.

April 4-7–Oil Heat Institute of America, 23rd National Oil Heat and Air Conditioning Exposition, New York, N. Y.

April 27-30 – 3rd Western Air-Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Los Angeles, Calif.

May 1-4 – Air-Conditioning and Refrigeration Institute, Annual Meeting, Hot Springs, Va.

May 19-21 – Refrigeration Research Foundation, Annual Meeting, Denver, Col.

May 22-25–Industrial Heating Equipment Association, Hot Springs, Va.

May 22-26 – National Association of Refrigerated Warehouses, Annual Meeting, Denver, Col.

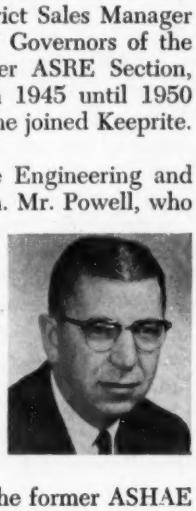
June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

People

Thomas F. Facius, a 1951 mechanical engineering graduate of Tulane University, advances to the position of Chief Engineer of Baltimore Aircoil Company, Inc., from that of Research Engineer. Having served previously with General Electric Corporation and York Corporation, he joined BAC in 1955. At present, Mr. Facius is a member of the ASHRAE Project Committee for the Proposed Revision to "Method of Testing for Rating Remote Evaporative Condensers".

Donald C. McKeen has assumed proprietorship of the Thermal Control Associate Store in Ottawa, leaving his position as Montreal District Sales Manager for Keeprite Products, Ltd., but remaining on the Board of Governors of the Montreal Chapter, ASHRAE. Past-Chairman of the former ASRE Section, Mr. McKeen was with Linde Canadian Refrigeration from 1945 until 1950 and with Murray Air Conditioning in 1950 and 1951, when he joined Keeprite.

Herschel F. Powell has been named Director of Appliance Engineering and Research for Kelvinator Div of American Motors Corporation. Mr. Powell, who was made Chief Engineer for all of the company's products last year, now assumes the responsibilities formerly held by **Dr. L. A. Philipp,** who has retired. Prior to joining Kelvinator in 1955, he had been with Gibson Refrigerator Company in Greenville, Mich., where he was Assistant Manager of Engineering. Educated at the University of Michigan, he was elected to membership of the former ASRE in 1956, and edited the household refrigeration chapter of the ASRE Data Book.



H. R. Roth, Secretary-Treasurer of the Ontario Chapter of the former ASHAE for the past 22 years, has been appointed General Sales Manager, Engineering Products, of American-Standard Products (Canada), Ltd. Formerly with Canadian Sirocco Products, Mr. Roth will handle air conditioning products and heat exchangers.

William E. Beggs, a life Member of ASHRAE, died on October 11th at the age of 70. Associated with the heating and plumbing industry since 1906, Mr. Beggs was President of W. E. Beggs, Inc., a contracting firm.

Richard A. Wolff, now Deputy Commissioner of the New York City Department of Air Pollution Control, resigned from Wolff & Munier, Inc. Founder of that firm in 1919 with **Leon L. Munier,** he has also held several government positions, aiding in the organization of the Office of Production Research and Dept. of the War Production Board, and serving as Assistant to the Director during the organization period. Later he became Chief of the Industrial Processes Branch of this Office, also serving as a member of the Technical Industrial Intelligence Committee, Joint Chiefs of Staff. A member and past-officer of many organizations, Mr. Wolff has served as President of the New York Chapter, ASHRAE.

Robert Hockman, deceased, had attended the University of Cincinnati, Miami University and Massachusetts Institute of Technology, and worked as a chemist for Kroger Food Foundation. He was the author of a paper, "Refrigeration of Produce in Small Walk-In Coolers," which appeared in Refrigerating Engineering.

Raymond C. Kelly has been appointed Executive Secretary of the Consulting Engineers Association of California, this appointment having recently been authorized during a meeting of the Directors in Los Angeles. Mr. Kelly comes to the position with a background of mechanical engineering training at Purdue University and the University of Arizona, and 15 years experience in engineering construction followed by 10 years in association management. Currently serving as Secretary-Treasurer of the California Society of Association Executives, he is a past-Director of the American Society of Association Executives.

Stephen Balough is now Chief Engineer at Kenmore Machine Products, Inc., Lyons, N. Y., in which capacity he will be responsible for new product development in cooperation with sales management and field requirements. For twelve years prior to joining Kenmore, he served variously with the General Electric Company as an engineer in the Household Refrigerator Dept, as Development Test Laboratory Engineer, Advance Design Engineer and as Product Design Engineer.

C. B. Morrison, deceased, was elected to Life Membership of the former ASRE in 1951. 73 at the time of his death, he had been with York Corporation since 1920, when he was a resident engineer in Shanghai, China. In 1925 he organized York-Shipley Company of China as a subsidiary of York Corporation, continuing as President of the company until 1940. At that time he assumed the Managing Directorship of York-Shipley Ltd. of London, retaining this position after his appointment, in 1948, as Director of Foreign Operations for York Corporation in New York City.

Richard H. Weber, formerly Vice President and Sales Manager of Consolidated Industries Corporation, a subsidiary of Welbilt Corporation, has been elected President at a meeting of the Board of Directors.

John I. Trimble died on September 9th at the age of 54, ending 31 years of service with Surface Combustion Corporation. Educated at Carnegie Tech and the University of Florida, he joined the company as a laboratory assistant, advancing to Sales Engineer, District Manager, Manager of Sanitrol Engineering and, finally, Manager–Product Engineering and Development. A member of the former ASHAE, he had served on the Research Committee.

Frank A. Merrill, until his death on September 4th, was Senior Partner and Chief Engineer of Merrill Associates, Consulting Engineers, a firm organized in 1953. Born in 1892, Mr. Merrill was educated at George Washington University and had, since 1915, been involved in heating and ventilating. During his career he worked as Engineer in Charge of such projects as Harvard University (heating and ventilating for 28 buildings), Providence (R. I.) Lying-In Hospital and New Hampshire State College Chemistry Building.

George Boeddener, Managing Director and Secretary-Treasurer of the National Warm Air Heating and Air Conditioning Association for nearly 20 years, has retired. During his time in office he was responsible for greatly increasing the recognition, membership and activities of the association.

Neil H. Peterson was Owner of Neil H. Peterson Company from 1926 until his death on October 13th at the age of 63. A member of the former ASHAE since 1937 and a past member of Council, Mr. Peterson had been active in both national and chapter affairs. From 1939 through 1943 he served on the Board of Governors of Golden Gate Chapter, becoming Vice President in 1940 and President in 1941. He was a chapter delegate that same year and an alternate from 1948 through 1950. During the years 1941, 1947 and 1949 he served on the Nominating Committee as a member, Chairman and Vice Chairman. For the term 1950-51 he was an alternate to the Chapters Conference and from 1951 to 1953 he served concurrently as a member of Council and the Finance Committee, becoming Chairman of the latter in 1953.

Bernard E. Proctor, Head of Massachusetts Institute of Technology's Dept of Food Technology, died on September 24th at the age of 58. Dr. Proctor had, since his election to membership in 1938, been active in the former ASRE, as well as in other societies, having served as President of the Institute of Food Technologists and Chairman of the American Chemical Society's Div of Agricultural and Food Chemistry. The author of many articles appearing in Refrigerating Engineering, he was a member of the Publications Committee in 1945 and Associate Editor of the ASRE Data Book in 1946 and 1950. From 1939 to 1942 he was Chairman of Technical Committee No. 3 on Biology and, in 1955, served on the International Affairs Committee.



Arthur K. Piercy, a physical engineer formerly with Green, Blankstein, Russell and Associates, becomes Chief Engineer of Alpha Manufacturing Company, Ltd.

Others are saying——

that . . . . . on refrigeration systems, the design of long suction lines interconnected with multiple direct expansion coils probably creates more of a design problem than any other refrigerant piping. Some of the problems encountered are: maintaining sufficiently high gas velocities through vertical risers to return oil, maintaining a continuous pitch toward the compressor throughout any horizontal run to return oil, avoiding unnecessary traps or dead-ended lines where oil can accumulate, precautions to be taken when suction line may be located in cold ambient due to condensation during system shutdown, pressure drop limitation due to refrigeration capacity penalty and noise and vibration transmission. The preferred method of handling mechanical cooling with separately located air handling system is by the use of a chilled water cooling system. If the direct expansion type system must be used, time will be well spent in analyzing the design of the suction line piping regarding these operating problems. *Air Conditioning, Heating and Ventilating, October 1959, p 61.*

that . . . . . air conditioning in cars of the future will be completely automatic with interior temperature and humidity varied automatically to provide continuous comfort as the car travels from the heat of the desert to the snows of the mountains. *Detroit Engineer, October 1959, p 8.*

that . . . . . enabling one aviation company to support relatively flimsy honeycomb core materials so they can be machined to a variety of precision dimensions is a recently-developed refrigeration technique, known as ice chucking. This process consists of filling a core made of welded thin metal foils with water, which is then solidified. After the core is machined, it may be cleaned by melting the ice and then using compressed air to blow out residual water droplets where rapid drying action is desirable. *Industrial Refrigeration, October 1959, p 14.*

Candidates for ASHRAE Membership

Following is a list of 137 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before December 31, 1959 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note:
* Advancement † Reinstatement

REGION I

Connecticut

POTTER, A. C., Dvlpt. Engr., Torrington Manufacturing Co., Torrington.

Massachusetts

BARRETT, J. H., Pres., John H. Barrett, Inc., Mattapan.

BATTING, R. A., Designer, Leo J. Crowley, Cons. Engr., Boston.

GINNS, W. R., Chief Mech. Engr., Steco Engineering Corp., Canton.

New Jersey

D'ARTAGNAN, S. J., Staff Engr., Kramer Trenton Co., Trenton.

NUBEL, G. C., Supvsr. Dvlpt. Engrg., Air Reduction Sales Co., Jersey City.

New York

ANDERS, W. L., Vice-Pres., A. I. McFarlan, Inc., New York.

BARON ROSAS, HECTOR, Engr. in Training, Carrier Corp., Syracuse.

BEHRER, R. Q., Mgr. & Engr., Behrer-Nason Co., Mineola, L. I.

COLLINS, F. R., JR.,* Proj. Engr., Joseph Davis Inc., Buffalo.

DICKENSON, R. D., Repr., Johns-Manville Sales Corp., New York.

ELSAESSER, R. C., Sales Engr., E. J. Eddy Inc., Buffalo.

HAINES, J. T., Engrg. Trainee, Carrier Corp., Syracuse.

HELMERS, H. O., Sales Engr., John J. Nesbitt, Inc., Syracuse.

HUGHES, DANIEL, Pres., North Shore Heating & Cooling, Woodbury.

KELLY, T. E., Mgr., Trane Co., Latham.

LUCAS, J. F. C., U. S. Army, Long Beach.

PARK, B. Y., Mech. Engr., Designer, Voorhees Walker Smith Smith & Haines, New York.

PECK, R. D., Chairman of the Board, Asbestos Construction Co., Inc., New York.

WONG, KENT, Jr. Designer, Voorhees Walker Smith Smith & Haines, New York.

REGION II

Canada

ARMITAGE, FREDERICK, Chief Engr., Commercial Leaseholds Co. Ltd., Hamilton, Ont.

BAILEY, J. E., Sales Promotion, Warden King, Downview, Toronto, Ont.

BELLINGHAM, ALLEN, Mech. Engr., Wirtanen Electric Co. Ltd., Edmonton, Alta.

COCKLE, D. R., Installations Supvsr., Wiggs Walford Frost & Lindsay, Toronto, Ont.

COPPOCK, A. R., Proj. Captain, O. G. Moffat Ltd., Hamilton, Ont.

FUOCO, DONAT, Design Draftsman, J. L. Richards & Assoc. Ltd., Ottawa, Ont.

GEAKE, L. W., Proj. Engr., L. H. Schwindt & Co. Ltd., Burlington, Ont.

MCKAY, R. F., Design Engr., Brown & Root, Edmonton, Alta.

MITCHELL, J. A., Secy.-Treas., L. H. Schwindt & Co. Ltd., Burlington, Ont.

MURRAY, M. V., Resident Sales Repr., Powers Regulator Co. of Canada, Ltd., Hamilton, Ont.

OLO, R. V., Mech. Designer, Comber & Mack, Montreal, Que.

POTTS, R. E.,* Indus. Sales Supvsr., Consumers Gas Co., Toronto, Ont.

SCOTHORN, A. D., Sr. Mech. Engr., Dept. of Public Works, Ottawa, Ont.

SZABO, VINCENT, Proj. Engr., L. H. Schwindt & Co. Ltd., Burlington, Ont.

WILLIAMS, L. M., Supvsr. Htg. Dept., Warden King Ltd., Downsview, Ont.

REGION III

Maryland

KLEINMAN, HENRY, Pres., Kleinman Bros. Inc., Baltimore.

Pennsylvania

CIORLETTI, P. P., Flame Safeguard Specialist, Minneapolis - Honeywell Regulator Co., Philadelphia.

LANOIS, G. D., Sales Engr., Westinghouse Electric Co., Philadelphia.

LAWTON, E. S.,† Engr., John P. Murdoch Co., Philadelphia.

OLDS, R. N., Office Mgr., T. F. Rockwell, Cons. Engr., Pittsburgh.

PAETOW, H. E., Appl. Engr., Frick Company, Waynesboro.

SCHOLHAMER, G. J., Sales Engr., General Electric Co., Philadelphia.

Virginia

BELL, C. E., Repr., Hajoca Corp., Richmond.

BUTLER, N. J., Mech. Engr., Reynolds Metals, Richmond

MCKENNA, J. J., Sales Engr., Powers Regulator Co., Arlington.

West Virginia

SAMMER, J. E., Mgr., Johnson Service Co., Charleston.

REGION IV

Florida

FLANIGAN, F. M., Associate Professor, University of Florida, Gainesville.

PEPPER, L. B., Repr., Central Air Conditioning & Sheet Metal, Inc., Miami.

QUATTLEBAUM, F. M., Repr., Gustin-Bacon Mfg. Co., Jacksonville.

North Carolina

SISK, K. A.,* A-C Engr., Bahnson Co., Winston-Salem.

REGION V

Illinois

LASCHOBER, R. R., Research Associate, University of Illinois, Dept. of Mechanical Engineering, Urbana.

Indiana

KELLEY, W. Y., A-C. Engr., George Koch Sons, Inc., Evansville.

KOCH, W. B., Co-Op Engr., Whirlpool Corp., Evansville.

NICOLAS, R. A.,† Proj. Engr., Eli Lilly & Co., Indianapolis.

SPHUNG, E. R., Sales Repr., Weil McLain Co., Michigan City.

Ohio

ERNST, J. T., Repr., Mussun Equipment Co., Cleveland.

GOUHIN, J. E., Appl. Engr., Columbus Air Conditioning Corp., Columbus.

JOLLY, J. G., Proj. Engr., Nutone, Inc., Cincinnati.

LEWIS, D. L., Prod. Dvlpt. Engr., American Standard, Industrial Div, Columbus.

MOORE, R. R., Br. Mgr., Minneapolis-Honeywell Regulator Co., Columbus.

RAYNAUD, W. L., Maint. Engr., USAF, WCUFES W-PAFB, Dayton.

SWANECK, A. J., Jr., Design Engr., Westinghouse Electric Corp., Columbus.

WILLIAMS, H. W., Proj. Engr., Air-Maze Corp., Cleveland.

REGION VI

Illinois

BRUCKNER, A. A., Sales Engr., Trane Co., Chicago.

JOESTING, F. D., Staff Engr., Minneapolis-Honeywell Regulator Co., Morton Grove.

KING, B. F., Supvsr. Appl. Engrg.

Group, Minneapolis-Honeywell Regulator Co., Morton Grove.

Iowa

AKERS, C. D., Sales Office Mgr., Dunham-Bush, Inc., Marshalltown.
STEWARD, C. R., Design Engr., Stanley Engineering Co., Muscatine.

Michigan

JAMISON, R. M.,* Prof. Mech. Engrg. & Dir. Engrg. Research, Wayne State University, Detroit.
WELLER, P. A., Prod. Engr., American Standard, Industrial Div, Detroit.

Minnesota

CHASE, F. R., Vice-Pres., Torit Manufacturing Co., St. Paul.

Wisconsin

HOLMES, K. L., Asst. to Director of Engrg., Johnson Service Co., Milwaukee.
LAUBENHEIMER, E. G., Mgr. Prod. Design Drftg., Johnson Service Co., Milwaukee.
LOEBL, F. W., Sales Engr., Young Radiator Co., Racine.
SCHMIDT, R. H.,* Engr., Young Radiator Co., Racine.

REGION VII

Alabama

FOWLER, R. E., Sales Engr., Bell & Company, Mobile.
MARTIN, W. C., JR., Com. Power Sales Engr., Alabama Power Co., Birmingham.

Kentucky

FETTEROLF, C. F., Sales Engr., Aluminum Co. of America, Louisville.
RIVERS, R. D., Supvsr., Fundamental Research, American Air Filter Co., Louisville.

Louisiana

BLUE, D. O., Chief Engr., S. S. Ulua, United Fruit Co., New Orleans.
CASSISI, C. S., JR., Estimator & Purch., A. S. Chevis, Inc., New Orleans.
GAUDET, J. P., Sales Engr., Industries Sales Corp., New Orleans.

Missouri

BRAND, B. B., Chief Engr., Havens Cooling Towers, Kansas City.
PETERSON, R. L., Sales Engr., Trane Co., Kansas City.

Tennessee

CAMPBELL, G. S.,* Pres., Campbell & Jones, Inc., Chattanooga.
O'BRIEN, J. O., Engrg. Salesman, T. J. O'Brien Engineering Co., Memphis.
WALKER, C. A., Br. Mgr., Ilg Electric Ventilating Co., Memphis.

REGION VIII

Arkansas

CARTER, J. T., Sr. Appl. Engr., Minneapolis-Honeywell Regulator Co., Little Rock.

Texas

ALLEN, G. E., Sales Engr., American Standard, Industrial Div, San Antonio.
CONLEY, B. L., Vice-Pres. Har-Con Eng. Inc., Houston.
JENNE, N. E., Proj. Engr., Natkin & Company, Houston.
NUTT, H. L., A-C. & Htg. Designer, Carter & Burgess, Ft. Worth.
POLEMA, T. R., Sales Engr., Johnson Service Co., Houston.
THOMAS, J. S., Engr., Harlan Engineering Co., Lubbock.

REGION IX

Colorado

RHOADES, J. L., Estimator, McCombs Supply Co., Denver.

Nebraska

THOMSEN, C. L.,* Engr. in charge of Mech. Design, Leo A. Daly Co., Omaha.

REGION X

Arizona

COHEN, SOL, Pres. & Owner, Phoenix Airconditioning, Phoenix.
EGLESTON, R. L., Sales Engr., Johnson Service Co., Phoenix.

California

ALEXANDER, J. G., Htg. & Cooling Specialist, American Radiator & Standard Sanitary Corp., San Francisco.
BURSIK, F. J., Mech. Engr., Federal Housing Administration, Los Angeles.
FULTON, R. L.,* Appl. Engr., Albert Rebel, Inc., Los Angeles.
MAYFIELD, R. W.,* Engr., Griffith & Dyer Co., Fresno.
RAUZY, J. F., Estimator, Luppen & Hawley, Sacramento.
TURLEY, J. C.,* Design Engr., L. A. O'Meara, Mech. Engr., Sacramento.
WHITE, E. B., A-C. Engr., Reliable Steel Supply Co., Los Angeles.

Oregon

MEDEARIS, K. C., Sales Engr., Trane Company, Portland.

Washington

DAVIS, W. Z., Partner, Culler-Gale-Martell & Norris & Davis, Spokane.
HART, H. S., Contr. Mgr. & Partner, Brower Co., Seattle.
KNOX, E. H., Mgr., Holaday-Parks Fabricators, Inc., Seattle.
OVERMYER, E. J., Research Engr., Boeing Airplane Co., Renton.
SPECKER, D. E., Mech. Engr. & Dept. Mgr., Wells & Wade Hardware, Inc., Wenatchee.

British Columbia

FRANKLYN, D. A., Mgr., Western Mechanical Services, Ltd., Vancouver.
JACKSON, C. E.,† Mgr. Refr. Div, Fred Welsh & Son Ltd., Vancouver.
HEUSING, J. H., Gen. Mgr., John H. Heuring & Assocs., West Vancouver.
LAMBERT, M. C., Design Engr., D. W. Thomson & Co., Ltd., Vancouver.
STURDY, F. D., Mech. Engr., Department of Public Works, Victoria.
THOMAS, W. D., Sales Engr., H. J. Sayer & Co., Ltd., Vancouver.
THOMSON, D. J., Asst. Htg. Sales Engr., British Columbia Electric Co., Ltd., Vancouver.

U. S. POSSESSION

Puerto Rico

MORALES, N. V.,† Vice-Pres. & Gen. Mgr., Airko Air Conditioning Sales & Service Co., Inc., San Juan.

FOREIGN

Chile

AMENABAR, ANDRES, Tech. Mgr., Lecaros, Amenabar & Cia. Ltda., Santiago.

England

COUCHMAN, W J.., Htg. Engr., Shell-Mex and B. P. Ltd., Strand, London.

Italy

BORGHI, GAETANO, Cons. Engr., & Gen. Mgr., S. F. Italiana, Milano.
GALLAGHER, F. H., Tech. Cons. Marelli Aerotecnica, Milano.

Switzerland

LOEFFEL, ROBERT, Directeur-Commercial, Technicair SA, Geneva.
SALATHE, FRITZ, Joint Proprietor, H. Geissberger & Co., Basel.

Thailand

HOUTMAN, J. G., Eng., Belgo-Thai Agencies, Bankok.

Venezuela

BLASCHITZ, BERNARDO, Design Engr., Maquinariap Mendoza C.A., Caracas.
MORALES, M. J., Chief Engr., Creole Petroleum Corp., Cabimas, Edo Zulia.

West Indies

BROWN, LESLIE, Owner, Toppers Refrigeration, Kingston, Jamaica.

STUDENTS

BEZNITZ, J. E., Michigan College of Mining & Technology, Houghton, Mich.
EWING, D. L., Michigan College of Mining & Technology, Houghton, Mich.
GALBREATH, J. W., Purdue University, Lafayette, Ind.
HARRELL, G. D., Michigan College of Mining & Technology, Houghton, Mich.
HEWITT, H. H., Michigan College of Mining & Technology, Houghton, Mich.
KITTINGER, D. C., Evansville College, Evansville, Ind.
MCCORMICK, D. C., Michigan College of Mining & Technology, Houghton, Mich.
OVASKA, A. A., Michigan College of Mining & Technology, Houghton, Mich.
PARIKH, B. R., Michigan College of Mining & Technology, Houghton, Mich.

BULLETINS and CATALOGS

Filter-Drier. Redesigned, this line incorporates a "Microwall" filter enclosure cited as completely encasing the desiccant on all sides and removing all solid foreign matter from the refrigerant before it enters the desiccant chamber. Full specifications, ratings and recommendations, as well as cut-away illustrations, are presented in 6-page Bulletin D-5.
McIntire Company, Livingston, N. J.

Mass-Air Extractor. Utilizing the convection current principle, the Thermoflow unit is a gravity roof ventilator designed to exhaust large air masses. Friction loss has been nearly eliminated by the short, unrestricted travel distance. Engineered for heavy industrial applications, units may be installed singly, multiples side-by-side, multiples end-to-end or multiples of double units. Flyer TF-59.
Western Engineering and Manufacturing Company, 4114 Glencoe Ave., Venice, Calif.

Baseboard Model Heater. Electric heating panels replace baseboards without sacrificing room space, providing even heat with no flames or explosion hazard. Available in 500, 1000 and 1500 watt, panels are thermostatically regulated. Cuts outline installation procedure in 4-page Bulletin 27-150.
Westinghouse Electric Corporation, Staunton, Va.

Stainless Steel Cooling Coils. Two flyers describe this manufacturer's line of coils for sub-zero and high-temperature service. Suited to the recovery of processing acids or control of fumes, these coils can be furnished of gas-tight construction for handling air contaminated with varying concentrations of acid vapors.
Rempe Company, 340 N. Sacramento Blvd., Chicago 12, Ill.

Electric Generating Plants. More than 45 basic models of gasoline and Diesel engine-driven generator sets are listed in 8-page Catalog F-146. Each series of plants is described in detail, with specifications for both engine and generator given to simplify selection for specific needs. A chart of representative models within each specific series outlines such details as capacity of the plant, model number, voltage, starting method, dimensions and weight.
D. W. Onan & Sons, Inc., 2515 University Ave. S. E., Minneapolis 14, Minn.

Pipe-Size Valves and Fittings. Leak-tight pressure systems can be made in a matter of minutes and joints can be made and unmade many times without damage using the line of high-pressure pipe-size valves and fittings described in 12-page Bulletin 4072. These valves and fittings are equipped with lens-ring gaskets and union-type joints. The lens-ring gasket is self-energizing with a pressure seal that tightens as internal pressure increases.
American Instrument Company, Inc., 8030 Georgia Ave., Silver Spring, Md.

Standard Industrial Thermometers. In-line pointer and scale on these models are cited as eliminating parallax error and providing easy readability at any eye level. Recalibration is easy with an external adjustment feature, located on the side of the bezel. Specifications for two models, back- and bottom-connected, are included in Flyer 09-103-B 7-59.
Weston Instruments, Div of Daystrom, Inc., Newark 12, N. J.

Ice Cream Freezers. Models 15 and 30, covered by this flyer, are the newest additions to the Electro Freeze line of fully automatic soft ice cream

(*Continued on page* 78)

REGION III TOURS BALTIMORE AIRCOIL PLANT



Highlighting a full program of elections, discussions and speeches was a tour of Baltimore Aircoil Company, arranged for delegates and guests of the Region III Committee Meeting in Baltimore by John Engalitcheff, Jr., President of BAC and member of the Finance Committee. Among those in attendance were: Merrill Blankin, Chairman UEC Fund Raising Committee; John Chandler, Region III Representative; J. H. Fox, ASHRAE 2nd Treasurer; W. A. Grant, ASHRAE 2nd Vice President; Cecil Boling, ASHRAE past-President; John Engalitcheff, Jr.; ASHRAE President A. J. Hess; H. F. Spoehrer, ASHRAE past-President; F. Y. Carter, ASHRAE 1st Treasurer; R. C. Cross, ASHRAE Executive Secretary; S. Y. Smith, Baltimore Chapter President; John Everetts, Jr., ASHRAE 4th Vice President and Region III Coordinator; W. H. Krueger, III, Baltimore Chapter 2nd Vice President; William Rock, Baltimore Chapter Secretary; and F. W. Hofmann, ASHRAE Assistant Secretary

ASHRAE JOURNAL

Editorial Index for 1959

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are vibration free··sleeve or ball bearing

Today, many motors are installed in areas where noise must be held to a minimum — in hospitals, churches, schools, office buildings, restaurants and similar locations where quiet is essential or desirable.

Such installations have created a need for larger polyphase motors that are exceptionally quiet and vibration-free. Wagner has filled this need by expanding its line of polyphase resilient mounted motors to include standard ratings through 10 hp.

If you have an application that calls for a smooth running motor, cushioned by resilient mountings, it will pay you to specify these Wagner Motors—a complete range of ratings from 1 through 10 hp.

Constant research and development have kept Wagner up front in electric motor design for more than 65 years—made the name Wagner one you can trust in choosing electric motor drives.

Your nearby Wagner Sales Engineer can help you select the *right* motor to meet your requirements. There are Wagner branch offices in 32 principal cities.

Wagner Electric Corporation
6379 PLYMOUTH AVENUE, ST. LOUIS 14, MISSOURI

WM59-13

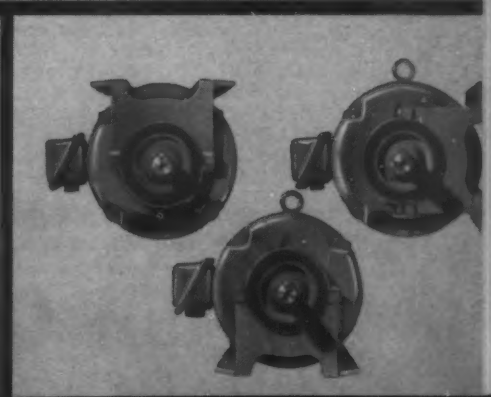
SLEEVE OR BALL BEARING. These motors are furnished with quiet running steel-backed babbitt lined sleeve bearings that have high load carrying capacity. Ball bearings can be supplied when desired.

NEOPRENE CUSHIONING RING. Annular mountings, of neoprene bonded to steel rings, cushion the motor in its cradle base to absorb the small amount of vibration that remains in the most carefully balanced motor.

CEILING, SIDEWALL OR HORIZONTAL MOUNTING. You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. The motor is designed to remain completely drip-proof in any horizontal position.







BULLETINS

(*Continued from page 72*)

freezers. Model 30, which has two two-hp compressors, is reported to have an extremely large capacity with relation to other double-head freezers, while Model 15, with a two-hp condensing unit and a 1½-hp beater motor with a gear reducer, is cited as being excellent for high volume locations.
Port Morris Machine, Inc., 712 E. 135th St., New York 54, N. Y.

Recorders. Provided in 12-page Bulletin GEA-6933 is buying information on a complete line of recording instruments, including dimensions and chart speeds, operating specifications, applications, features and accessories. Recorders are grouped by accuracy class (¼, one, two and three%) for convenient selection. Also described are specialized recording instruments available, such as spectrophotometers, recording vibrometers, automatic oscillographs, self-balancing potentiometers and speed recording systems.
General Electric Company, Schenectady 5, N. Y.

Heat Exchanger. Rated at 300,000 Btu/hr and able to deliver 125 psig steam in 20 sec, this exchanger is portable and can be wall mounted, suspended or directly attached to process apparatus. Complete product description and applications are included in 4-page Bulletin 59.
Turb-O-Heat, Inc., 1133 E. 35th St., Brooklyn 10, N. Y.

Piping Practice Wall Chart. Suitable for posting on shop bulletin boards, this 17 by 22-in. chart, "Recommended Piping Practice", may be used by installation and maintenance personnel and individuals requisitioning valves of all types. Divided into five sections: "Basic Valve Types", "Connections Normally Used," "Installation and Maintenance Tools", "Installation" and "Operation and Maintenance", the chart has illustrations of products from this manufacturer's line of valves, engineering specialties and lubricating devices on the back.
Lunkenheimer Company, Cincinnati 14, Ohio.

Cold Storage and Shock Absorbing Doors. Offered in two flyers is information on this manufacturer's various types of doors. Catalog Sheet 166 gives details on the compressed air-powered door operator now optionally available with Prest-O-Matic Industrial and Cold Storage Doors, while Sheet 2059 describes the shock-absorber door.
Clark Door Company, 515 Hunterdon St., Newark 8, N. J.

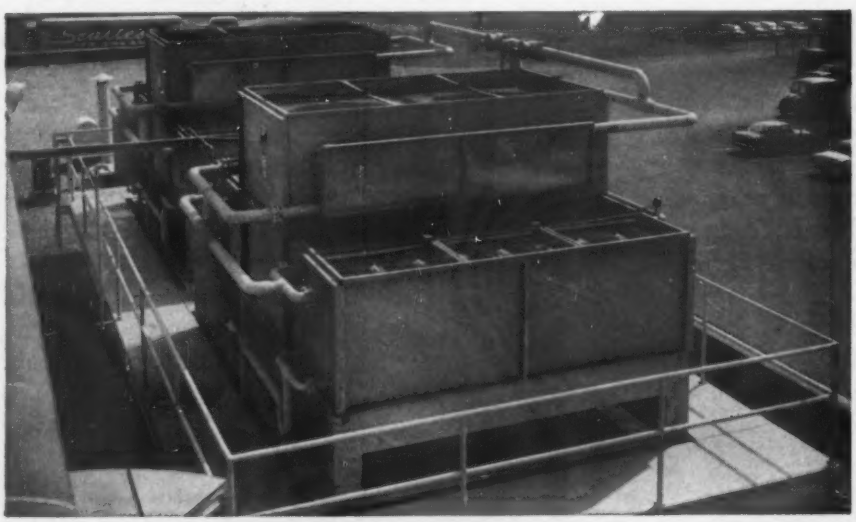
Vibration Absorber. Useful in a wide variety of applications, Keldur dampens and absorbs vibration caused by machinery, isolating the machine from its foundation. Descriptive of the ways in which this material can be used is 4-page Bulletin 1959.
Beltran Associates, Inc., 1133 E. 35th St., Brooklyn 10, N. Y.

Perimeter Air Distribution Systems. Continuous blower operation, humidity control, filtration with either disposable or washable filters and prevention of drafts are features cited for Electric Thermo-Base systems in 8-page Bulletin TB-226-Rev. 1. Three models: standard, glass wall (for installation flush with the floor) and commercial, are available. Typical room zoning is shown and seven steps in sizing the system are given.
Gerwin Industries, Inc., Thermo-Base Div, Michigan City, Ind.

Pipe Thread Fittings. Requiring only light to medium wrench torque for seal-tight assembly of any piping or tubing installation, thus eliminating distortion and damage to valves, pumps, compressors, etc., caused by high wrench torque overtightening, Tru-Seals can be used to prevent leakage on new piping or to stop dripping on old installations. Uses, advantages and method of installation of these pipe thread fittings are contained in a 4-page bulletin.
Flick-Ready Corporation, Tru-Seal Div, 7N015 York Rd., Bensenville, Ill.

Line Temperature Detector. Flexible and multi-point, this detector can protect areas, storage, processes and equipment from overheat. Lengths of tubing may be wound, bent or strung into any desired configuration, each detecting over-temperature at any point along its length. Specific installations can be had in greater lengths, but nominally up to 100 ft of sensing element may be connected to one control unit. Bulletin MC-183, four pages.
Fenwal, Inc., Ashland, Mass.

Centrifugal Blower. Air Unit No. 89C21 may be used for cooling electronic tubes, ventilating small electronic equipment cabinets, cooling hot spots and many other applications. Flyer 5812 describes the unit, listing its features and recommended applications. Cuts give major assembly dimensional data. Among performance



MODERN NIAGARA CONDENSERS PAY FOR THEMSELVES IN EXTRA SAVINGS

These Niagara condensers are lower in first cost and assure you of trouble-free automatic refrigeration. Special features: "Aeropass" coil removes super-heat to give you condensing at lower temperatures and prevent loss of capacity by the scaling of condenser tubes; "Oil-out", oil separator between pre-cooling and condensing coils gives you always an oil-free system; "Panel-Casing" construction gives you access to every part of the condenser for inspection and maintenance. Operating engineers say these condensers "save half the work of running a refrigerating plant". Managers who know costs and profits prove that Niagara condensers bring them great returns in power savings, water savings and reduced maintenance expense.

Write for Bulletins 131 and 142.

NIAGARA BLOWER COMPANY

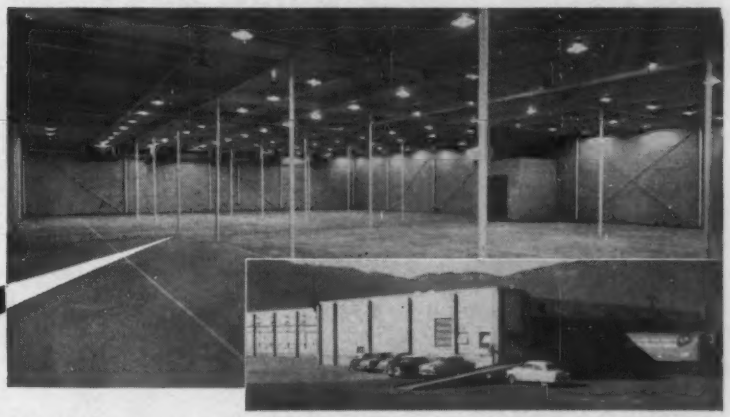
Dept. RE12, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U.S. and Canada

FREEZING at -50° or STORING at -10°

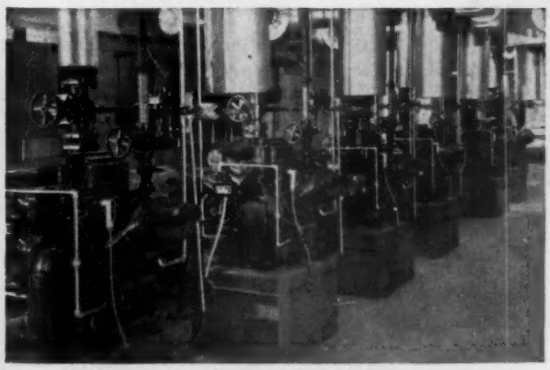


ARCADE FARMS COOPERATIVE, INC., Blasdale, N.Y. In this hardening tunnel, packaged ice cream moves on endless conveyors. Tunnel temperature, minus 50° F. This entire tunnel and much of the plant's other production equipment was engineered by Creamery Package. Shown is discharge end of tunnel.



RALPH'S GROCERY COMPANY, LOS ANGELES. In this 86' x 140' freezer room, frozen foods are stored at minus 10° F. "Push-button" operation of the entire refrigeration system reduces supervision to a minimum. Inset shows exterior, compressor room and loading dock.

Refrigeration Experience, Engineering and Equipment *PAY OFF!*



MILLEDGEVILLE STATE HOSPITAL, GA.
Strong heart for a modern refrigeration system—a battery of CP Type "K" Ammonia Compressors.

Whether it's FAST FREEZING of fresh vegetables, fruits, meats or cooked foods...or sub-zero STORAGE, you get precise freezing control and safe protection for your products when you choose CP Refrigeration.

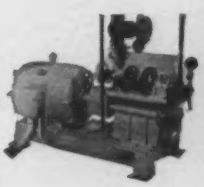
CP engineers offer you the benefits of generations of refrigeration experience—engineering know-how that understands thoroughly the needs of *your* operations—equipment that's planned *right* and built *right* to do *your* job best.

If you are considering new installations or expansion of facilities, get the help of CP planning now.

THE *Creamery Package* MFG. COMPANY
General and Export Offices:
1243 West Washington Blvd., Chicago 7, Illinois
Sales Branches in 23 Principal Cities

Creamery Package Mfg. Co. of Canada, Ltd.
267 King St., West, Toronto 2B, Ontario

CP "VS" Compressors
2- 4- and 6-cyl. models
in cap. from 2
to 30 tons.



THE MARK OF DISTINCTION IN REFRIGERATION EQUIPMENT

data provided are motor specifications and a delivery vs. static pressure curve for the blower.
American Radiator and Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

1959 Estimating Catalog. Cited as covering more than 80% of the items normally used by engineers in the fields of refrigeration, heating, ventilation and air conditioning, this 36-page pricing guide offers specially-prepared tables to enable quick selection of blowers, fans, coils, evaporative condensers, valves, fittings, etc. Presented are: air cooled condensers to 300 ton, new line of cooling towers to 200 ton, self-contained heavy duty packaged air conditioners to 100 ton and a balance loader to load compressors artificially during periods of reduced load.
M. Blazer & Son, 173 Market St., Passaic, N. J.

Heat Exchange Tubes. Engineers associated with the design and manufacture of heat exchanger equipment used in the process industries may be interested in 8-page Bulletin TB-431. Attributes of this line of Lectrosonic heat exchanger tubes are described, including good fit in tube sheets, ease of fabrication and optimum fluid flow.
Babcock and Wilcox Company, Tubular Products Div, Beaver Falls, Pa.

Glass Electric Radiant Heaters. Describing this manufacturer's complete line of baseboard, wall panel and ceiling-recessed glass electric radiant heaters is Catalog GC-106. Featured is technical and descriptive information on the uses and operation of these heaters for home, business and commercial applications.
Berko Electric Manufacturing Corporation, 212-40 Jamaica Ave., Queens Village 28, N. Y.

Winter Use of Cooling Towers. Cold weather operation of outdoor towers raises the possibility of trouble from freezing of lines, ice formation on fill and too low suction and head pressure at compressors. Suggestions offered in Flyer 598 may help to avoid occurrence of these conditions.
Water Service Laboratories, Inc., 615 W. 131st St., New York 27, N. Y.

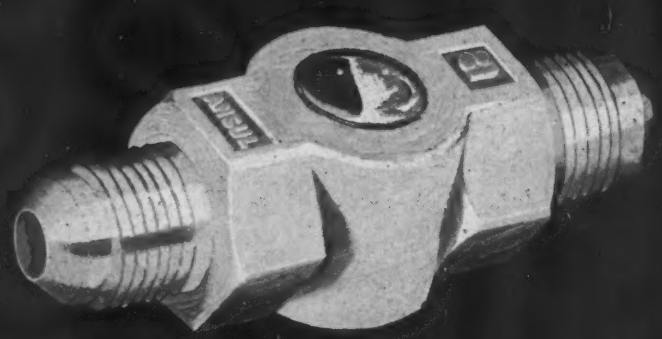
Hydraulic Fluid. Cited as providing excellent lubrication with dependable fire protection, Sunsafe Fluid is a water-in-oil emulsion in which the oil is the continuous phase. Available in one grade, this fluid may be used in any hydraulic system where a fire-resistant-type fluid is considered desirable or necessary at pressures up to 2000 psi and operating temperatures up to 150 F. Four-page Bulletin 55 provides a complete description of the product.
Sun Oil Company, Industrial Products Dept, Philadelphia 3, Pa.

High Temperature Unit Coolers. Engineering data on this manufacturer's newest development in the refrigeration line, Tri-way Spasaver high temperature unit coolers, is the subject of Flyer S 741.03. Developed for service in rooms over 34 F, the product is detailed in the bulletin, which includes a 17-point Table of Dimensions keying to diagrammatic cross-sections of the unit. Seven models comprise the series, with nominal capacities ranging from ½ to 2 ton.
Drayer-Hanson, Div of National-U. S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

Temperature Measurement Devices. In a 96-page catalog, this manufacturer presents his entire line of instruments. Section headings are aircraft, miniature and industrial thermocouples; resistance bulbs; wire and "Ceramo" wire; connectors, panels, switches;

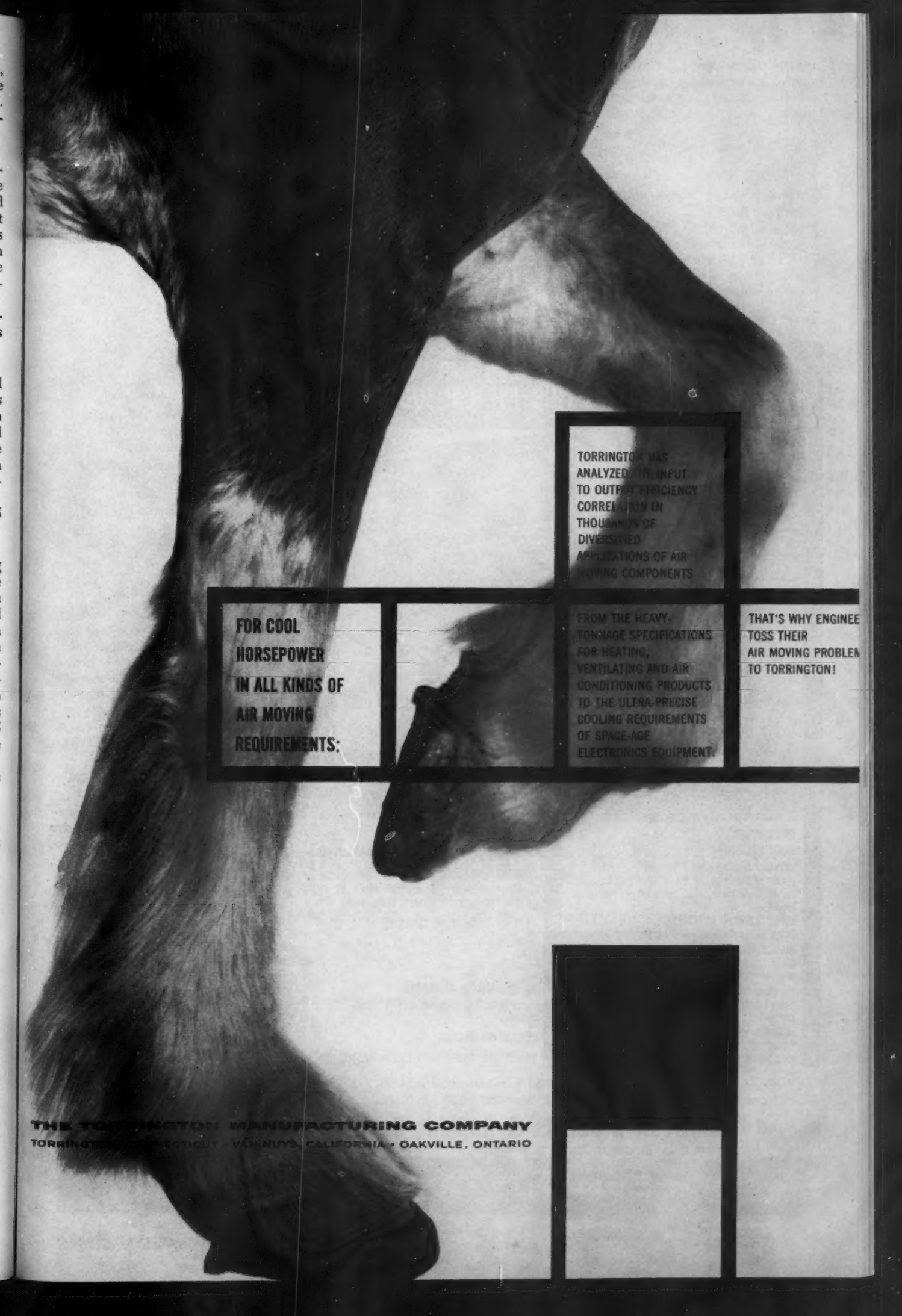
ANSUL LINE-FLO SIGHT GLASS

Now you see it . . . now you don't! When the refrigerant is at full charge, the Ansul Line-Flo Sight Glass shows "FULL" clearly, distinctly. But should the charge drop to a low level, the word becomes blurred. Glass is bonded faultlessly to metal in the Line-Flo Sight Glass. No gaskets, no joints, no solder. It's rugged enough to withstand the most unusual strains and vibration . . . and it's guaranteed leakproof! When a moisture indicator is needed in addition to a sight glass, the Ansul Super Dry-Eye is recommended.
ANSUL CHEMICAL COMPANY, MARINETTE, WISCONSIN



ANSUL

REFRIGERATION PRODUCTS
FIRE FIGHTING EQUIPMENT
INDUSTRIAL CHEMICALS


TORRINGTON HAS ANALYZED THE INPUT TO OUTPUT EFFICIENCY CORRELATION IN THOUSANDS OF DIVERSIFIED APPLICATIONS OF AIR MOVING COMPONENTS
FOR COOL HORSEPOWER IN ALL KINDS OF AIR MOVING REQUIREMENTS:
FROM THE HEAVY-TONNAGE SPECIFICATIONS FOR HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS TO THE ULTRA-PRECISE COOLING REQUIREMENTS OF SPACE-AGE ELECTRONICS EQUIPMENT.
THAT'S WHY ENGINEE TOSS THEIR AIR MOVING PROBLEM TO TORRINGTON!
MANUFACTURING COMPANY
VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

controllers; recorders; indicators; and special instruments, including a temperature monitoring system, cold junction units and a calibration console.
Thermo Electric Company, Inc., Saddle Brook, N. J.

Industrial Valve Buyers Guide. Intended as an all-inclusive information piece for valve specifiers, 24-page Bulletin 1012 cross-indexes this company's line with the valves of 16 major manufacturers and contains a list of frequently-used abbreviations, a valve trim chart, list of valves conforming to Federal Specifications and complete figure number descriptions. A breakdown of the product line by valve material and pressure class, and classification by type, disc design, seating arrangement, stem operation, bonnet and end connection serves as an additional guide to proper valve selection.
Ohio Injector Company, Wadsworth, Ohio.

Skylight-Ventilator Combinations. Roof ventilators incorporating Solaraire modifications utilize translucent Fiberglas top plates, available in various colors, to provide a combination skylight-ventilator. Flyer S-59 provides cuts and descriptions of four models.
Western Engineering and Manufacturing Company, 4114 Glencoe Ave., Venice, Calif.

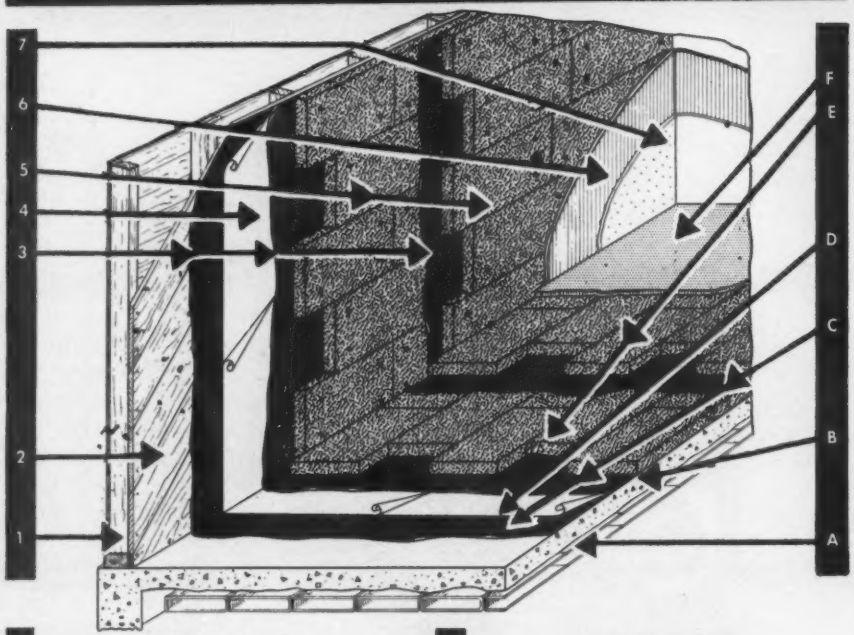
Electrical Insulating Varnishes. Having as its subject the selection and application of these varnishes, 36-page Catalog E-IVC(891)JR gives complete details on electrical and mechanical properties as well as operating temperature limitations. Included are charts, graphs and illustrations on temperature conversion, solvents, specific gravity, viscosity and other categories pertinent to selection of insulating systems. Other sections contain data on selection of the proper varnish, impregnation methods, baking and curing procedures and storing and handling suggestions.
Minnesota Mining and Manufacturing Company, Irvington Div, 900 Bush Ave., St. Paul 6, Minn.

Heavy-Duty Motor Starting Relay. Typical applications of this heavy-duty (up to 30 amp, 115 volt) current-type motor starting relay, the Klixon 6409 Series for single-phase ac appliances, are on motors for oil burners, submersible pumps and other stationary equipment having starting loads over 10 amp. Detailed information is contained in 4-page Bulletin STRE-4.
Texas Instruments, Inc., Metals and Controls Div, 34 Forest St., Attleboro, Mass.

Fiberglas Duct Fans. Where air containing acids or alkalies must be moved, these duct fans of all-Fiberglas construction provide performance equal to that of stainless steel or monel. Identical to standard belt-drive duct fans in design and performance, these are made in 20-, 24- or 28-in. diam. Flyer A-116.
Hartzell Propeller Fan Company, Div of Castle Hills Corporation, Piqua, Ohio.

Heating Coils. Describing the construction and operation of Kennard/Nelson Heating Coils, 32-page Bulletin HC-102 presents explanations, graphs, charts and illustrations for standard steam, hot water, steam distributing and double distributing coils. Featured are construction and dimension data, air friction charts, temperature rise charts, condensate rates, water velocity and pressure drop graphs, heat transfer factor graphs and net weights for different lengths and coil sizes.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

LAYKOLD PRODUCTS SEAL, HOLD AND PROTECT INSULATION ON THIS TYPICAL JOB



WALLS

1 **WOOD STUDS**
2 **WOOD SHEATHING**
3 **LAYKOLD INSULATION ADHESIVE**
Brush or spray at 23 sq. ft. per gallon. Allow to set (turn black) then press on membrane or blocks
4 **VAPOR BARRIER MEMBRANE**
Press into adhesive. Use 3" laps; 1 to 3 layers.
5 **INSULATION BLOCKS**
When first layer has been placed, set skewers and repeat for next layer of insulation.
6 **LAYKOLD MASTIC WEATHERCOAT**
Point joints and trowel scratch coat at 8 sq. ft. per gallon. Let dry.
7 **LAYKOLD WEATHERCOAT**
Trowel at 15 sq. ft. per gallon for water-resistant finish.

FLOORS

A **TILE OR GRAVEL FILL**
For ventilation vs. freezing of the sub-grade.
B **CONCRETE SUB-SLAB**
If new, use Hydropel integral admix at 1½ gallons per sack of cement. Gives a dry slab.
C **LAYKOLD INSULATION ADHESIVE**
Spray, brush or squeegee at 23 sq. ft. per gallon. Let set (turn black). Then press on membrane and block insulation.
D **VAPOR BARRIER MEMBRANE**
Press into the adhesive. Use 3" laps—1 to 3 layers.
E **INSULATION BLOCKS**
F **2" LAYKOLD HEAVY DUTY FLOOR MASTIC**

Get all the facts on the Laykold Line of products for cold insulation construction from our nearest office.

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BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

KRAMER

BETWEEN THE RAILS UNIT



Photo - ROYAL CASTLE COMMISSARY, MIAMI, FLA.

KRAMER Presents a New Evaporator Principle

B-R unit combines all the advantages of the gravity coil with the advantages of the fan type unit. The result of years of research and development, it is the evaporator that answers the problem when the installation requires that "extra" in performance.

LOW AIR VELOCITY: Discharge velocities are no higher than a gravity coil—there are no air blasts. Ideal for installations where people must work in a refrigerated room.

NO DEAD AIR SPOTS: By distributing the B-R units over the ceiling area, even temperature and humidity conditions can be maintained throughout the area.

SPACE SAVER: Fits between the rails without hindering the movement of the stored product; it takes no usable space.

IDEAL FOR THE MEAT INDUSTRY: The B-R unit has proven very successful in the refrigeration of fresh meat. Shrinkage is cut to an absolute minimum, slime and mold are controlled, and the bloom and flavor is maintained. Ideal for carcass chilling, meat cutting rooms, meat storage rooms, aging rooms, smoked meat storage as well as pork, bacon and sausage rooms, etc.

MANY APPLICATIONS: Can be furnished with a hot gas heated pan for temperatures below 30°. Available as an "F" or "L" THERMOBANK system with or without the compressor for temperatures of 32° or lower. The B-R designs include units for Refrigerant 12, Refrigerant 22 and ammonia.

Write for Bulletin R-462

KRAMER TRENTON CO. • Trenton 5, N.J.



air conditioning and refrigeration

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LARGEST PRODUCER OF AIR CONDITIONING UNITS OUTSIDE THE U.S.A.

WHAT ASHRAE CHAPTERS ARE DOING

(*Continued from page 67*)

outside temperature, the inside temperature often rose to 85 or 90 F, necessitating the use of various methods to keep out the sun's rays. Eventual solution to the problem was the installation of Glare-X glass, which consists of a screen vacuum sealed between two panes of glass. Tests indicated that 80 to 82% of the sun's energy was kept from entering the building by this means.

KANSAS CITY . . . A panel consisting of an architect, Mark Sharp; an engineer, J. R. DeRigne; a contractor, Henry Nottberg, Jr.; and a manufacturer's representative, Harold Burkhart, Jr., discussed "Closed vs Open Types of Specifications" at this group's first Fall meeting. Each panel member spoke briefly of the various types of specifications, advantages and disadvantages of each type and which ones they favored from their own viewpoint. Gilbert Hellmer was moderator.

Those attending a later meeting heard Charles O. Beacham, Chief Engineer with Carrier Corporation's St. Louis office, speak on "Applications of Absorption Refrigeration." Illustrative slides accompanied the talk, which covered principles of operation, methods of control, various applications and reasons for each, and advantages of this type of system.

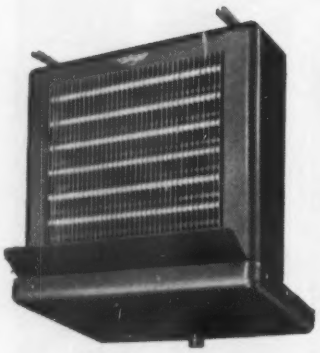
NORTHEASTERN OKLAHOMA . . . New bylaws for the Chapter, having been made available to the membership prior to the business portion of the evening's program, were discussed and voted on affirmatively at the October 19th meeting.

Presenting a talk accompanied by slides, Guest Speaker C. R. Apitz of Clark Brothers Company addressed members on the potentials of the gas turbine. Although in use for years, the gas turbine has not been popular until recently, when it was made available in smaller sizes, he stated, describing it as an energy converter, with the energy in two usable forms, one as shaft power for a prime mover, the other recovered exhaust heat. This latter may represent as much as two-thirds of the available energy of the turbine, and has, in the speaker's opinion, great potential for use with absorption-type air conditioning equipment as auxiliary heat. Utilization of recovered heat is making the gas turbine reasonably competitive in initial cost.

MONTREAL . . . Keen competition between supermarkets today calls for full efforts by the designers of these establishments in the consideration of economy of operation. Speaking on the subject "Waste Heat is Now Space Heat in a Supermarket," Reuben Brasloff, a partner in the firm of Mendel, Brasloff, Lassman and Sidler of Montreal, explored this problem at the October meeting. Outlining the development of supermarkets in recent years with regard to the changes being made in the refrigeration equipment used for the cold counters, he gave as an example an existing store. In this cited installation, the use of individual air-cooled condensers grouped in one location lent itself to application


It happened again in 1959 . . .
Tuttle & Bailey air distribution
equipment was installed in the
nation's significant buildings.
TUTTLE & BAILEY
division of Allied Thermal Corp. New Britain, Connecticut
Tuttle & Bailey Pacific, Incorporated, City of Industry, California

LARKIN
TOPS IN LOW TEMPERATURE

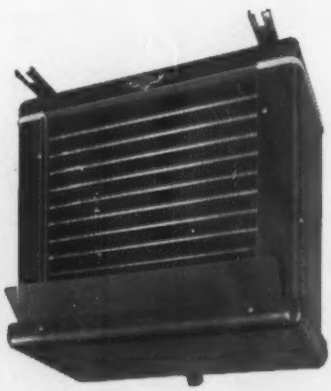


LARKIN
LOW TEMPERATURE
HUMI-TEMP

With Patented
FROST-O-TROL®
automatic hot
gas defroster

Secret of this efficient, easy-to-install unit is the factory installed patented metering orifice which controls hot gas in the defrost cycle and prevents slugging of refrigerant into the compressor. Thousands in use in the U. S. and many foreign countries.

LARKIN
ELECTRIC DEFROST
LOW
TEMPERATURE
HUMI-TEMP



Sealed electric heaters embedded in the coil defrost this unit by radiation, conduction and convection. Defrosting and refrigeration circuits are completely independent. Top efficiency and low operating cost are assured.

See your wholesaler, or write for bulletins 1032 and 1055.

LARKIN COILS INC.
519 Memorial Dr., S.E. P. O. Box 1699
ATLANTA 1, GEORGIA

of a heat recovery system, accomplished by introducing the heat given off by the refrigerating units to the air conditioning system. The only additions necessary to a standard system of air conditioning or ventilation were three additional dampers and a fourth sequencing stage in the control system. As much as 25% of the total capacity of the heating plant can thus be recovered, according to speaker Brasloff.

ROCHESTER . . . Speaking at a joint meeting of this Chapter and the Illuminating Engineering Society, Will S. Fisher of General Electric Company discussed integrated lighting and air conditioning systems. Current lighting recommendations, he declared, have reached a level where lighting loads may have considerable influence on the design of the air conditioning system. Projected levels of 300, 400 and 500 footcandle make it imperative to solve the problems of high radiant heat and internal loads.

LOUISVILLE . . . There is not necessarily a static relationship between the cost of goods or services and value, in the opinion of C. Michael O'Grady of General Electric Company, who spoke on "Better Design and More Profits Through Value Analysis" at the October meeting. To arrive at a goal of optimum value in anything, a set of steps was outlined by him, calling for evaluation of the worth of the function or product, comparing designs, securing all the facts, consideration of every possible source and of known but often neglected techniques. Since no design is ever perfect, it was contended that continued periodic value analysis can often lower manufacturing costs from 15 to 50%.

In the question and answer period following his address, some listeners questioned the applicability of value analysis to apparatus design work in which many ASHRAE members are engaged. Others felt that research and development engineers should not be encumbered with value analysis considerations. In reply, the speaker expressed the feeling that value analysis is a valuable tool which can be used advantageously to supplement any engineering endeavor.

DALLAS & FORT WORTH . . . Discussing observation perception, Timothy Waad of E. I. duPont spoke on the subject "Semantics of Sight" at the joint meeting of these two chapters held October 19th. Included in his topic was work simplification, industrial engineering, power of observation and audience participation.

WISCONSIN . . . Continuing its practice of having two speakers per meeting, this Chapter had, as preliminary speaker, John Folwell of Johnson Wax Company and, as the main speaker, Jack Harris of Korfund Company.

Considering such points as negligence of manufacturers in lack of services after equipment is sold, Folwell spoke on "The Consumer's Viewpoint". Suggestions offered as possibly improving customer-manufacturer relations were: thorough operating instructions to be made out for the complete plant on a new system, review of the entire system by the customer with the manufacturer's assistance once a year, use of experienced servicemen

it's the balance that counts . . . . that's why Drymaster® with balanced drying and filtering is the best engineered filter-drier you can buy today!





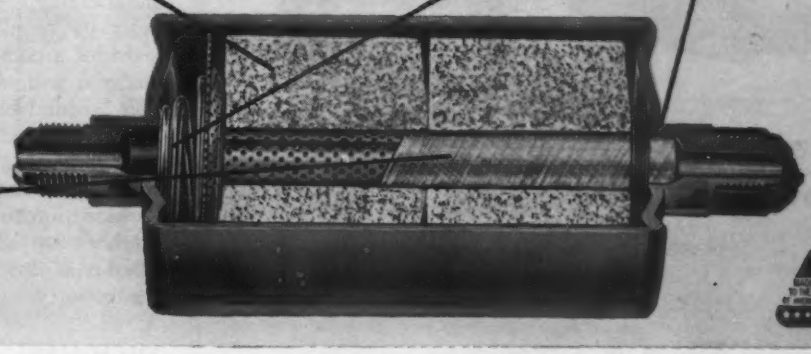
Drymaster Filter-Driers meet the most exacting needs of today's modern refrigeration system. Engineered and rated in *every* respect in accordance with ARI Standard 710-58, Drymaster does *both* filtering and drying perfectly . . . gives guaranteed balanced performance. To provide the versatility to meet the demands of every installation, Drymasters are available in a wide range of types, capacities and sizes with either male, female flare or copper solder-type end connections for easy installation . . . Drymasters are also available in combination with the Sightmaster Liquid Indicator.

Drymaster is engineered for today's modern refrigeration systems

HI-FI FILTER BLOCK DESICCANT—fully activated, pressure-molded briquette removes ALL moisture, acid, sludge and micron-size foreign particles. Unequalled in moisture absorbing capacity; surface and internal depth filtering is unsurpassed by comparable sized driers.

SHOCK-PROOF ASSEMBLY—Filter tube, alignment hub, conical spring and spacer at outlet end form cushion suspension for internal parts; heavy-welded body construction makes Drymaster Shock-Proof.

FILTER TUBE—perforated tube with monel screen makes a doubly effective safeguard against dirt and sludge.



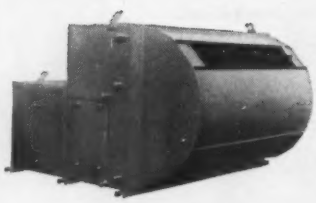


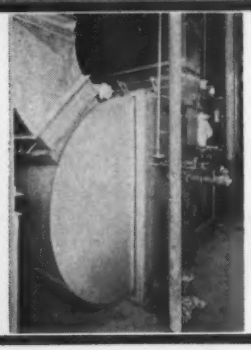
For sizes, complete information and specification on Drymaster Filter-Driers, send for new bulletin. Just released.

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273







24 PACE-SETTING NEW D-H HIGH
PRESSURE H.C.D. AIR HANDLERS DO IT
...AT NEW KROGER BLDG., CINCINNATI.

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and prompt shipment of parts. It was further proposed that the general contractor and consulting engineer have the system checked by one of the persons responsible for the design.

Stressing that the main aims of his organization's equipment was not to eliminate vibration but rather to isolate it, speaker Harris presented a talk on "Vibrations of Air Conditioning and Refrigeration Equipment". He reviewed the theory of vibration transmission and the materials used as dampeners, such as cork, rubber, layers of these two, and steel springs. Various applications described for the vibration isolators were fans, compressors, reciprocating pumps, air handling units, transformers and centrifugal compressors. Established during the question period which followed was the fact that vibration isolator installations are not possible under water.

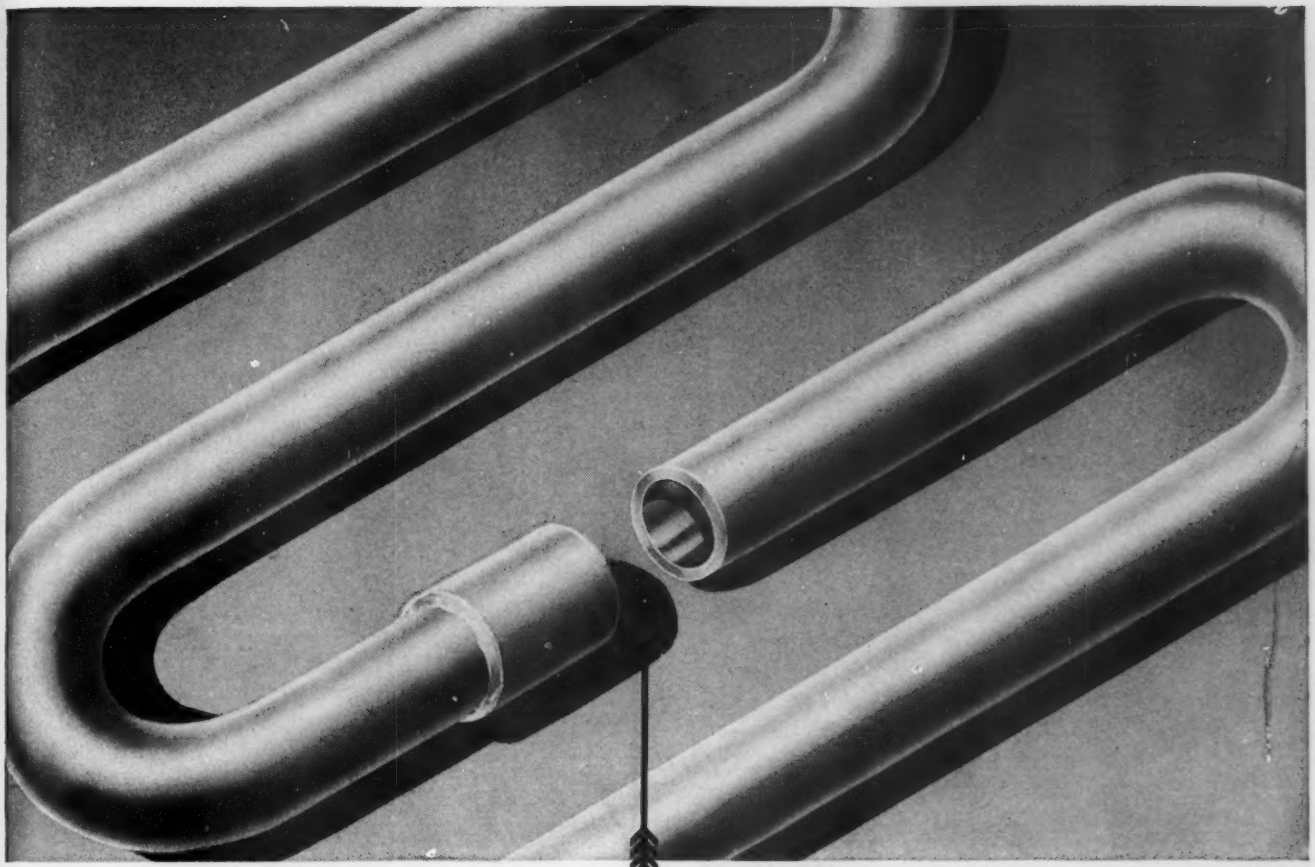
FLORIDA WEST COAST . . . Examining the various methods used in the design of duct systems, Steve Shelton, guest speaker at the October meeting, explored the advantages and disadvantages of the velocity reduction, equal friction and static regain methods, recommended that the last mentioned method be used in duct design for higher velocity systems. Stressing the importance of duct design with regard to the over-all efficiency of the system, he also discussed noise problems encountered in air distribution systems relative to the allowable noise as caused by dampers, turning vanes, branch takeoffs, grilles, etc.

NEBRASKA . . . Atomic power was the subject presented at the October meeting, with Dr. Glenn Murphy, Technical and Applied Mechanics Dept head, Iowa State University, delivering the talk, a general review of the various aspects of nuclear energy.

NEW YORK . . . Since the introduction a few years ago of foamed plastics as insulation for use in heating, air conditioning and refrigeration applications, its rapid degree of acceptance has been somewhat remarkable, according to a panel composed of Richard R. Voorhees, Frederick E. Sullaway, Jr., and Frederick S. Donnelly, Jr., of Armstrong Cork Company. Speaking at the October meeting, panel members agreed that this foamed plastics insulation owes its popularity primarily to the fact that it provides a combination vapor barrier and insulating material and, due to its flexibility, permits installation "around corners" without need for special preformed fittings.

Highlighting the program was a colored soundslide film tracing the growth of this material from its inception to the present. Shown in the film were methods by which plastics insulation has been applied to 45 installations of different types throughout the country.

MICHIGAN . . . Members attending the October 19th meeting of this group were taken on a tour of the Enrico Fermi Atomic Power Plant near Monroe, Mich., where a lecture and two films introduced them to the installation. Included in the tour of the plant, which contains such equipment as a fast



The two best ways to join copper tubing: HANDY & HARMAN

SIL-FOS & SIL-FOS 5

Installers as well as manufacturers of refrigerating, air-conditioning and heating equipment, contractors, designers and consulting engineers—all are finding that "the best thing in the joint" is Handy & Harman's silver brazing alloy SIL-FOS or SIL-FOS 5.

The benefits inherent in these alloys apply to the most complex joints and installations as well as to the simplest. With SIL-FOS, installation speed or production volume depends entirely on your particular needs; a few assemblies an hour to literally hundreds of thousands a day—SIL-FOS adapts readily. Here are what you and *your product* get with SIL-FOS brazing.

STRENGTH—The strength of a properly designed and brazed SIL-FOS joint exceeds that of the metals joined.

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CORROSION RESISTANCE—With occasional exceptions, SIL-FOS joints offer strong and lasting resistance to a host of corrosive media.

EASY INSTALLATION—FAST PRODUCTION—With SIL-FOS you can get any production you want—you have a choice of heating methods, jigging setups, inspection techniques, etc.

ECONOMY—Low flow point, fast brazing action, reduced labor costs and vastly reduced reject rate; plus the small amount of alloy needed to make a joint put SIL-FOS in a low-cost catagory unequaled by other methods.

Alloy	Silver Content %	Type	Starts to flow at °F	Starts to flow at °C	Free Flowing at °F	Free Flowing at °C	
SIL-FOS	15	Wide Melting Range	1185	641	1300	704	For use in joining ONLY nonferrous metals. Used particularly on copper, brass and bronze. Specially effective in joining pipe and tubing and on electrical work.
SIL-FOS 5	5		1195	646	1300	704	

Further details on SIL-FOS and SIL-FOS 5 can be had in the form of Technical Literature from Handy & Harman. **Send for Bulletin 20.** Our research and engineering people are ready and willing to help you with any metals joining problem or plan you may have.



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How to balance air conditioning, heating and ventilating systems with the ***NEW***

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breeder reactor, liquid sodium system with sodium pumps, heat exchangers and a 100,000 kw turbine, were visits to the Atomic Information Center, the reactor building and other accessible portions of the grounds.

BRITISH COLUMBIA . . . Illustrating his talk with slides, Donald Cousins of the Marley Company covered the fundamentals of water cooling in air conditioning, cooling tower equipment and maintenance, at this group's last meeting. Tracing the evolution of the cooling tower and problems of cooling water, he emphasized a few basic design principles. Pamphlets summarizing the important points in his address were circulated to the membership, to facilitate the question and answer period which followed.

CINCINNATI . . . Holding its first technical session of the year recently, this group had as speakers two officials of Keco Industries, a producer of refrigerating equipment. Presented by George Andrews and W. J. Downs was an illustrated talk on the construction and operation of a missile cooling unit.

Used to air condition instruments on such missiles as Atlas and Thor, and satellites such as the Discoverer series, these mobile units are able to conduct air at two different temperatures under high static pressures through long, flexible ducts, which is done with both centrifugal blowers and positive displacement pumps. Fitted into a compact trailer, units are protected against heat, cold, humidity, fungus, mud, dust and salt spray. Problems of design include the necessity of the unit's being explosion-proof, able to withstand jolting over rough terrain while maintaining accuracy of performance and not affecting nearby radio signals.

RHODE ISLAND . . . Explaining the various types of heating traps and methods of storing heat in large tanks of water underground, Henry E. Vogeli, Chief Development Engineer for American Brass Company, lectured on "Solar Heating" at this group's last meeting, accompanying his talk with slides. Expounding on piping systems and method of pumping in some detail, he pointed out that although wet earth is a good conductor of heat, heated tanks underground dry the surrounding earth, which then acts as an insulator.

PHILADELPHIA . . . Division of the October meeting into two sections, Educational and Technical, enabled members to hear two lectures in the course of the evening. Speaking during the Educational Session, Daniel E. Kramer of Kramer-Trenton Company presented a program covering "The Application of Air-Cooled Condensers to Large Tonnage Systems."

In an address intended to present the highlights of the major types of air conditioning systems applied to multi-story buildings, Fred Manget, Manager of the local Trane Company office and Technical Session speaker, showed what factors enter into selection of these various types of systems when applied to specific building types, such as new and existing structures, hotels and office buildings.



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Phelps Dodge Copper Tube for refrigerating, air conditioning and heating units!

1 Phelps Dodge has complete control of its copper tube from original source to finished product. The copper used in Phelps Dodge tube comes from Phelps Dodge-owned open-pit mines, is smelted in Phelps Dodge refineries and fabricated in modern Phelps Dodge mills. This overall Mine-to-Market control is assurance of highest quality and finest workmanship.

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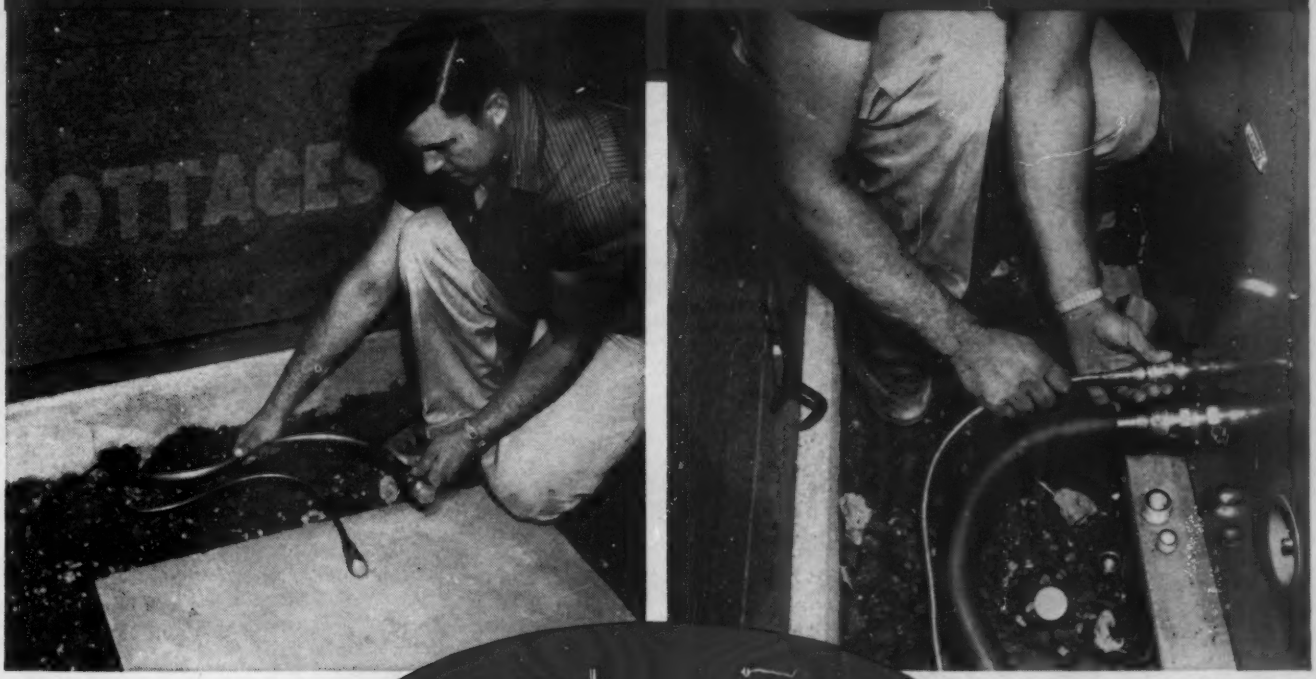
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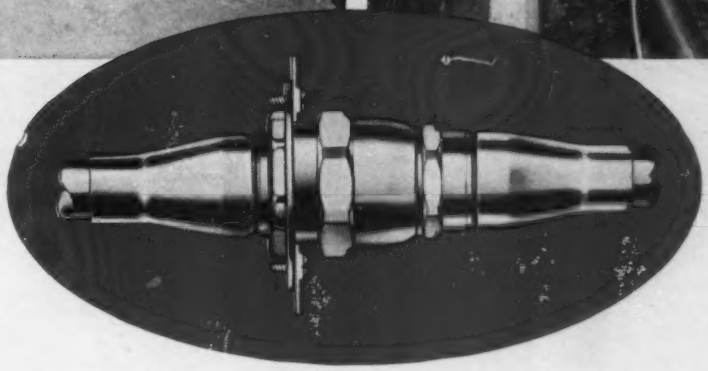
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Precharged tubing is formed and fitted to meet each installation need. Note Self-Sealing Coupling halves on tubing have protective dust plugs to protect thread and valve.



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Lennox is one of many equipment manufacturers who are users of the dependable 5500 Series Coupling on evaporator and condenser units.

The Aeroquip 5500 Series Self-Sealing Coupling features a leakproof design using only one mechanical joint. Each coupling half is brazed directly to tubing, eliminating adapters and screwed joints where leakage would be possible. Each coupling half seals tight until connected, preventing loss of refrigerant or inclusion of air into the system. As the coupling halves are joined by a hex union nut, the valves open to provide a full flow of refrigerant, with minimum pressure drop.

Aeroquip 5500 Series Self-Sealing Couplings are available in sizes to fit tubing from ¼" to 1⅛". Write for Bulletin IEB-32A for full details.

Listed by Underwriters' Laboratories, Inc.

Aeroquip

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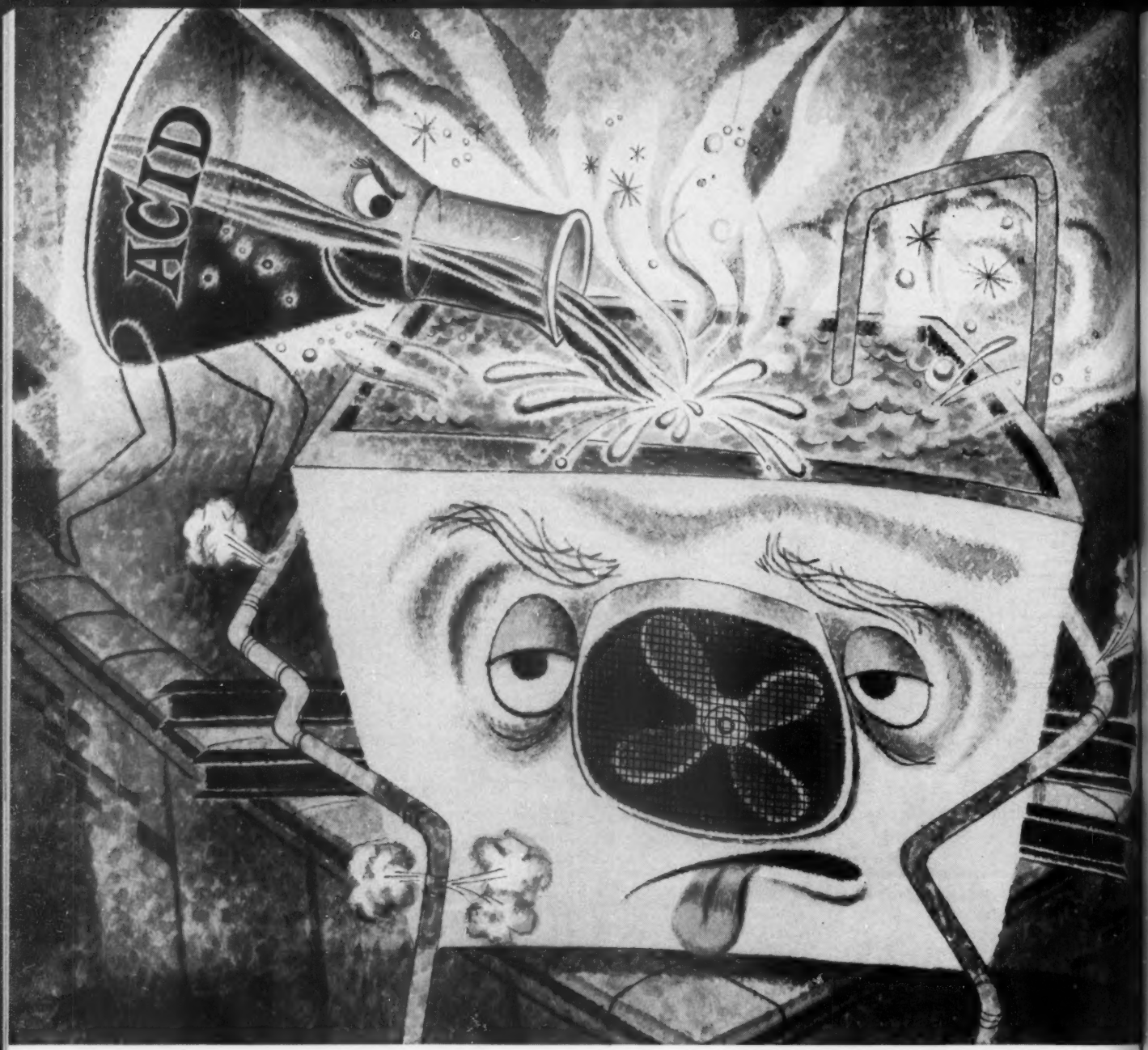


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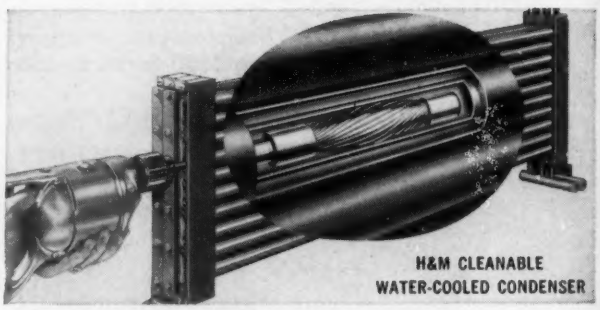
Will acid upset your cooling water system?

NOT if your water-cooled refrigeration condensers are cleanable mechanically like Halstead & Mitchell's

Scale and sludge deposits seriously reduce heat transfer in condensers and affect system performance unless removed. Deposits can be cleaned from H&M water-cooled condensers safely with a simple, mechanical tool—faster, more completely and at less cost! No need to risk acid damage to condensers, cooling towers and pumps.

Halstead & Mitchell condensers have brass headers which are easily and quickly removed for cleaning. Seamless copper tubing is arranged in double-tube design for true, positive counterflow heat exchange. U/L approved, condensers are readily set up in racks with multiple condensing units. Ask your local wholesaler for complete information, or write to Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pennsylvania.

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INSIDE STORY

reveals why Penn water valves stay on the job longer!

Look inside the Penn water valve shown below. See how the two diaphragms keep water away from the bellows, range spring and sliding parts. Water... with its rust, corrosion and sedimentation... never has a chance to attack these "working parts" and cause destruction. That's why the Penn Series 246 stays on the job much longer than ordinary valves!

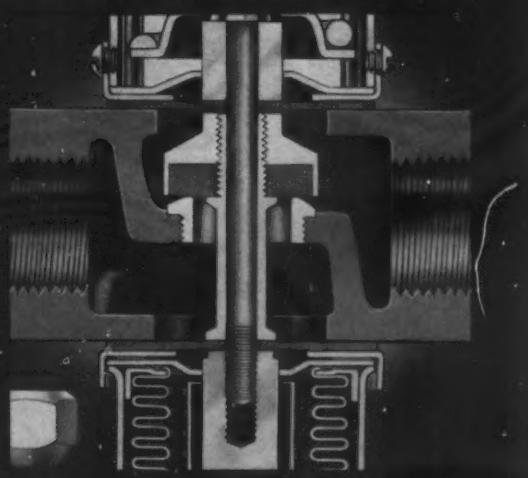
This is one of the many reasons why more manufacturers and installers buy Penn than any other valve and why we say... the Series 246 is your best buy! Ask your wholesaler, he'll tell you...

Try Penn on your next job!



Wide range of sizes and capacities available. All-Range model, suitable for both R-12 and R-22, available in ⅜", ½" and ¾" sizes.

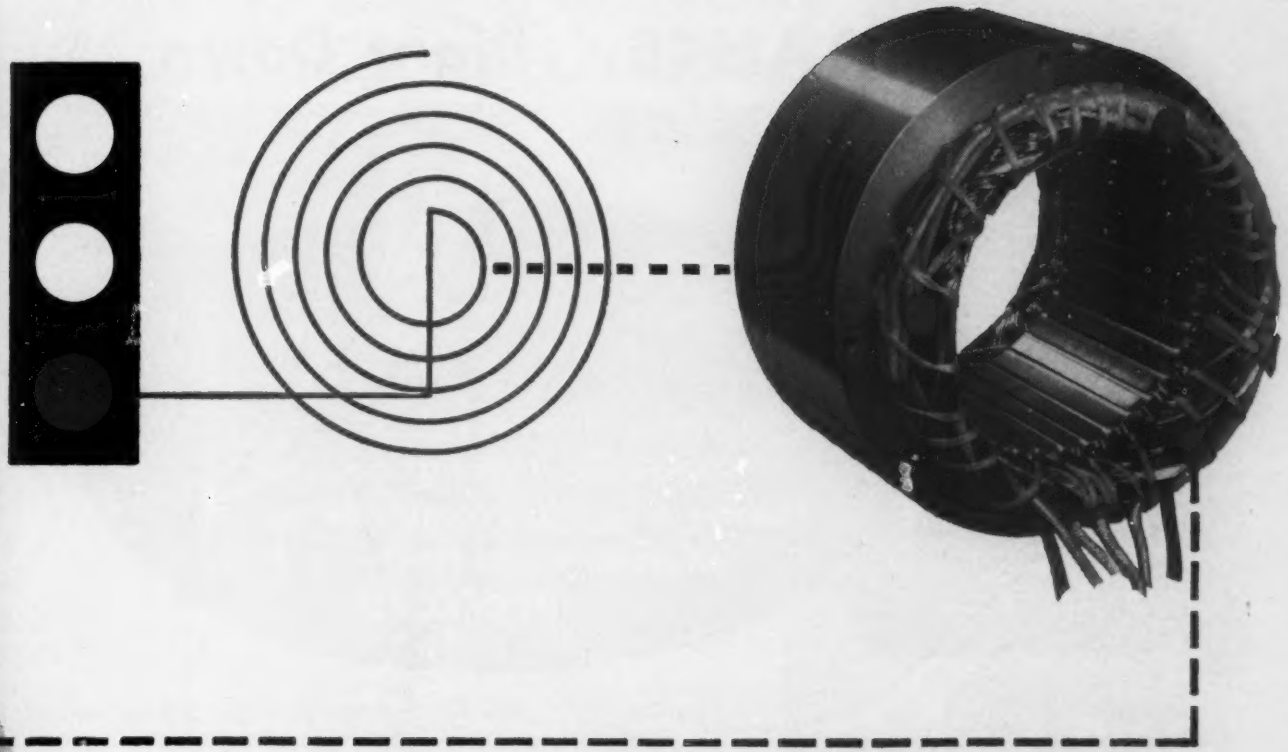
No rust, corrosion and sedimentation. Exclusive design keeps water away from bellows, range spring and sliding parts.



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At last, positive protection against motor overheating with this unique Westinghouse motor development. Smaller than an aspirin, the heart of the Guardistor* motor is a PTC† Thermistor embedded in the motor windings to sense temperature rise immediately.

With normal motor temperatures, the thermistor has low resistance which remains nearly constant up to a predetermined critical temperature. At this temperature, a 100 to 1 or more increase in resistance occurs for a small increase in temperature. The resistance stops current flow activating a control designed to "WARN" or "STOP" a motor failure.

The Guardistor motor and associated control integrates all heat-causing factors of load, ambient, and power supply right in the motor windings to give you complete protection against motor burn-out.

*Trade-Mark
†Positive Temperature Coefficient

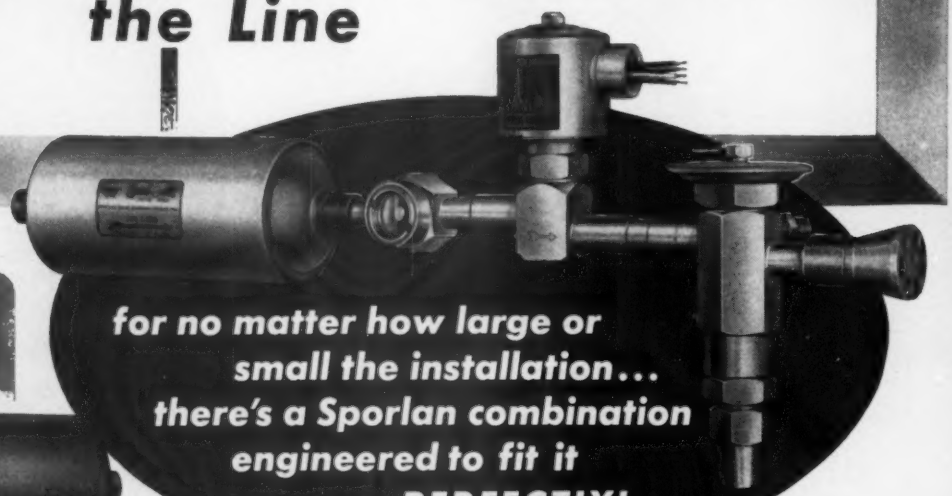
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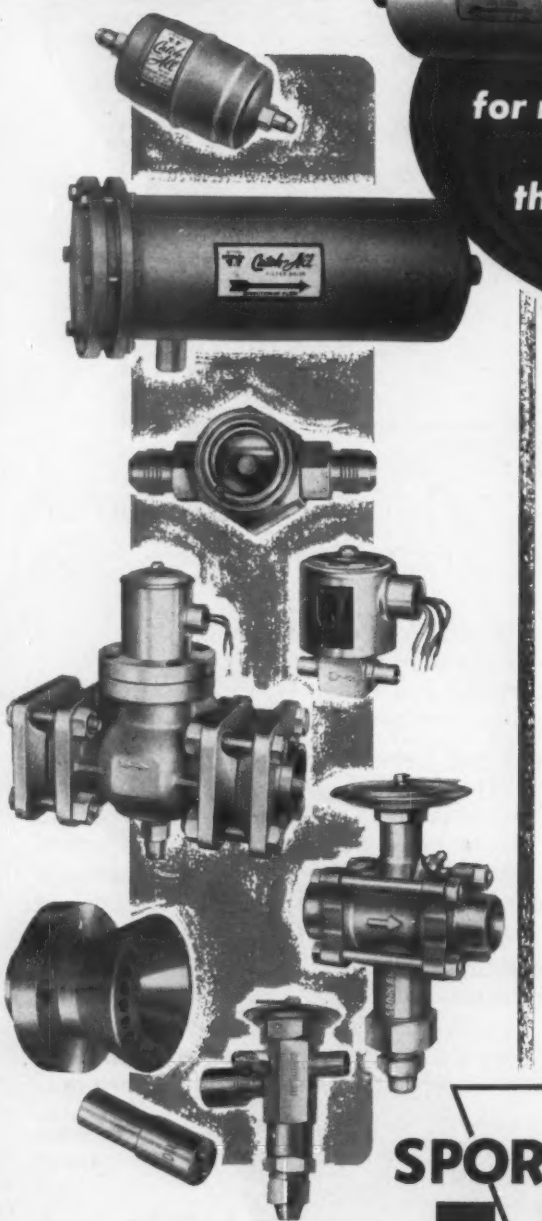
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Sporlan Catch-All filter-driers with the famous molded porous core, keep systems perfectly clean, perfectly dry and acid free!

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The superior design of **Sporlan Solenoid Valves** with Blue Seal Coils gives high MOPD ratings, permitting them to be used on applications with either refrigerants 12 or 22.

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So... whether your next air conditioning job is large or small, buy Sporlan throughout and get Peak Performance Right Down the Line!

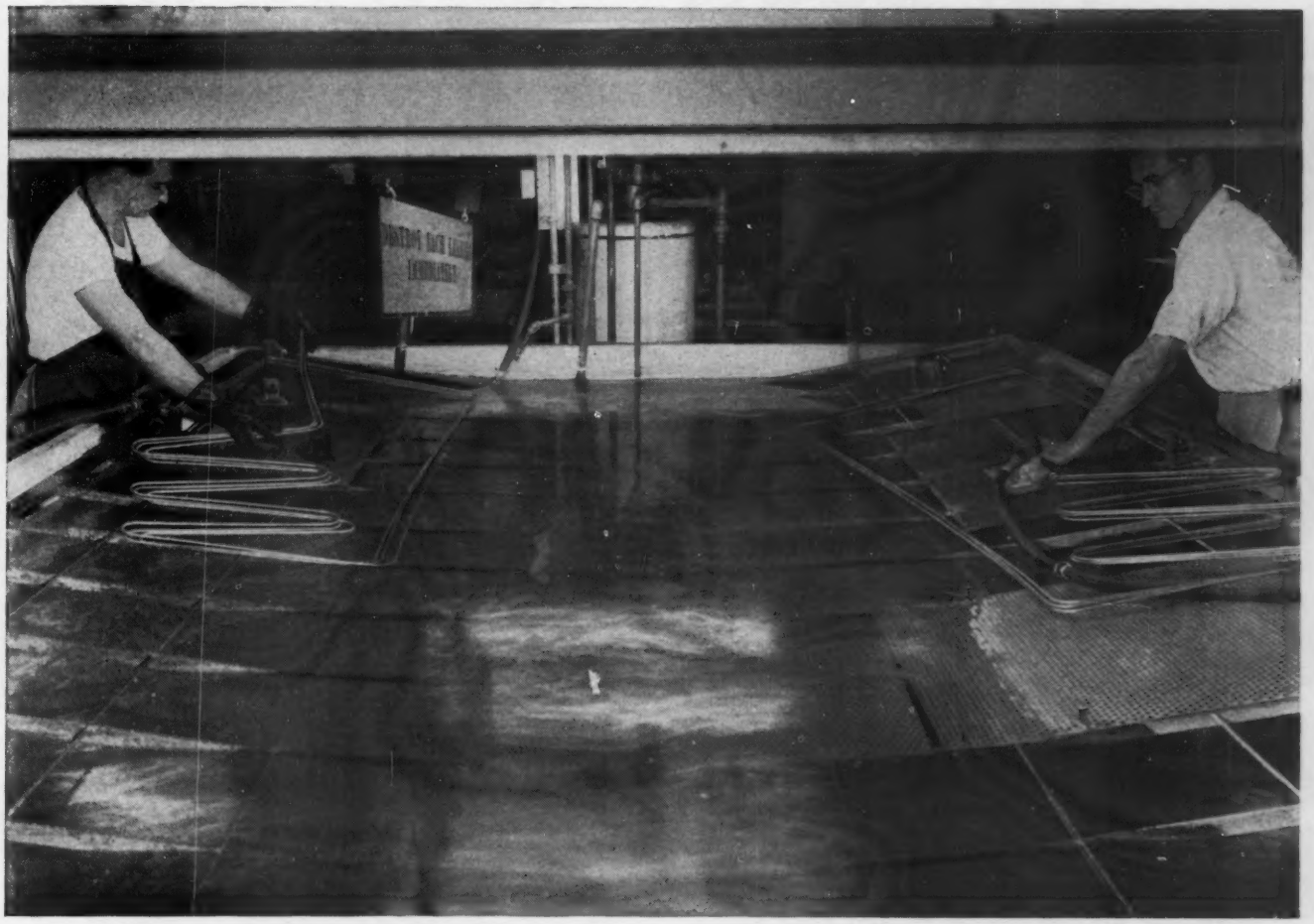
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Every inch of GM Steel Tubing is pressure-tested and cleaned. Solvent is introduced under pressure to all bulk coils, checking structural strength and assuring an I.D. free of internal residue. Then after your specifications take shape—as in the serpentines above—they are again tested under pressure to assure a clean, leak-proof tubing that will stand up under the most rigid conditions for the life of your product. Call a GM Steel Tubing Sales Engineer today. Put some of this top-quality tubing on test now. See how you can save time and money with the cleanest tubing you can buy. *Rochester Products Division of General Motors, Rochester, New York.*

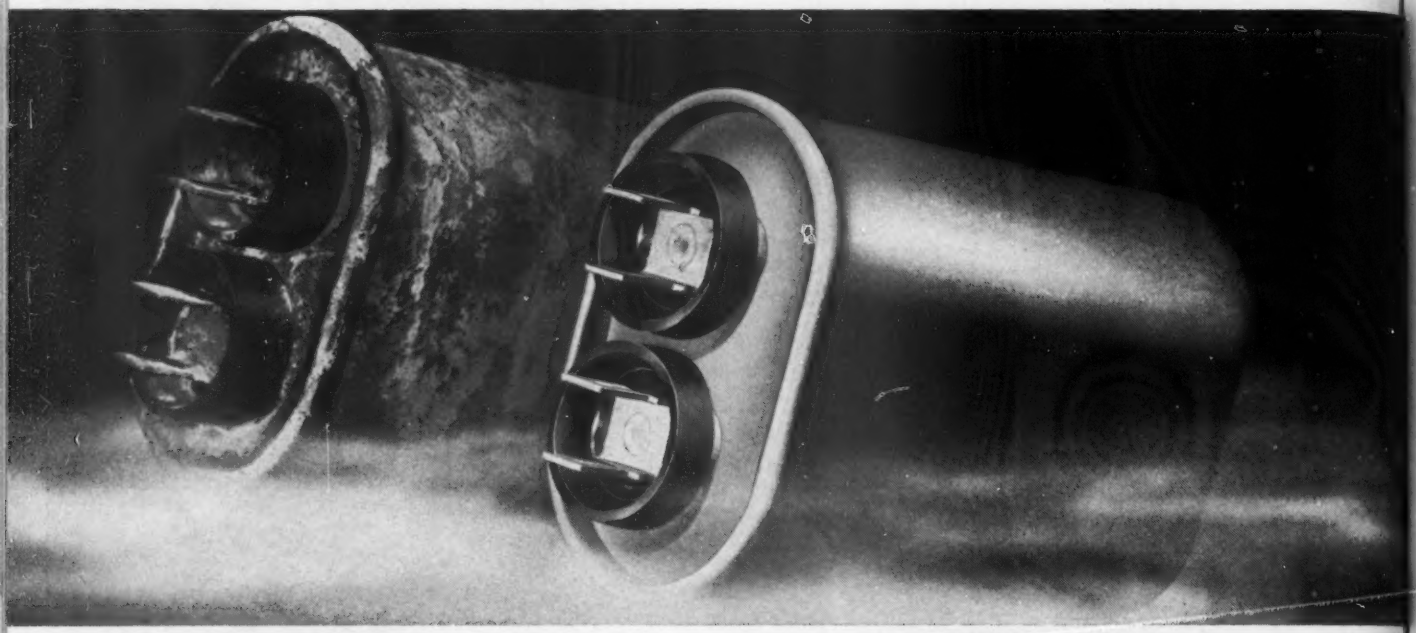
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AMERICA'S LARGEST MANUFACTURER OF REFRIGERATION TUBING

G-E Drawn-case Capacitors Now Offer Greater Protection Against Corrosion



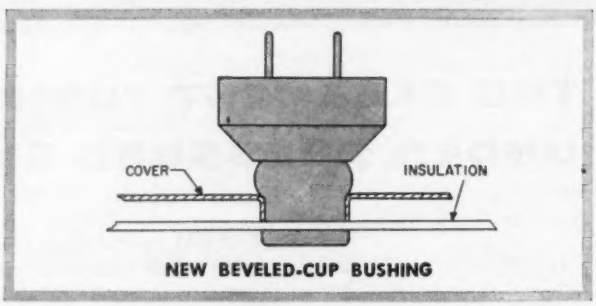
Unique Bushing Design and Automated Application of Granite-gray Paint Assure Uniform, Durable Finish

Accelerated tests in simulated industrial atmospheres proved that this new G-E Granite-gray paint finish inhibited rust and stain formation many times better than finishes used earlier.

Where other finishes were heavily corroded in as little as 250 hours in a 20% salt fog at 95F and 85-90% relative humidity, the Granite-gray paint showed only minor effects, even after 1000 hours.

Chosen only after comparative evaluation of 46 different finish systems under adverse climatic conditions, this remarkable new finish results in longer, trouble-free capacitor life.

To assure you of the maximum protection that Granite-gray paint offers, it must be applied in a uniform film completely covering the capacitor case. General Electric assures complete uniform coverage by use of a unique beveled phenolic-cup bushing and fully automated application of the paint. The new beveled cup facilitates complete paint protection of cover as well as case (above). While maintaining increased electrical creepage distance, the new cup shape also eliminates the collection of troublesome moisture around the terminals.



NEW BEVELED-CUP BUSHING

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For maximum protection against salt fog, industrial fumes, slinger condensate and other corrosive elements, specify G-E Capacitors with Granite-gray paint. Further information is available from your nearest G-E Sales Office, or write General Electric Company, Ft. Edward, N. Y.

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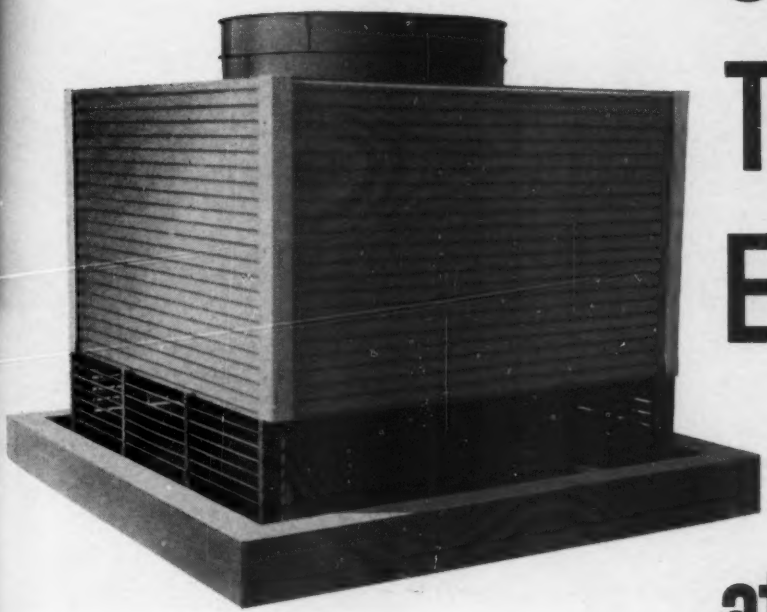
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Ask for our brochure that shows why Fluor Towers mean more efficient operation.

See our exhibit in Dallas at the 2nd Southwest Heating and Air Conditioning Exposition February First to February Fourth.

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COPPER TUBE

creates confidence in YOU!



"COPPER TUBE is in the 'specs' of all quality jobs"

says the consulting engineer

What other material has copper tube's *combination* of valuable properties? What other material resists corrosion so well... can be joined so easily... can take years of tough punishment... transfers heat so efficiently... is suitable for such a variety of refrigerants and lends itself to so many types of installation and fabrication processes? *There is none!*

In addition to all the performance features of copper tube... air conditioning and refrigeration men consistently find the overall cost of using copper tube to be lower than less durable metals. This is because copper tube is so much easier to work with... in the plant or on the job.

If you have a choice... always make it copper. It builds confidence in the job you do, the product you sell and in you.

Look for "Made in U.S.A." on all copper tube. The manufacturer's brand name and this symbol also are used by many U.S. copper and brass mills to designate tube products that meet the exacting standards of American industry.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

Specify Copper Tube for Air Conditioning and Refrigeration.

COPPER & BRASS RESEARCH ASSOCIATION • 420 LEXINGTON AVE., NEW YORK 17, N. Y.

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THE CLOSED-CIRCUIT EVAPORATIVE WATER COOLER

Serves many industrial and commercial liquid cooling applications by continually recirculating pure water through the RECOLD EVAPORATIVE WATER COOLER, assuring:

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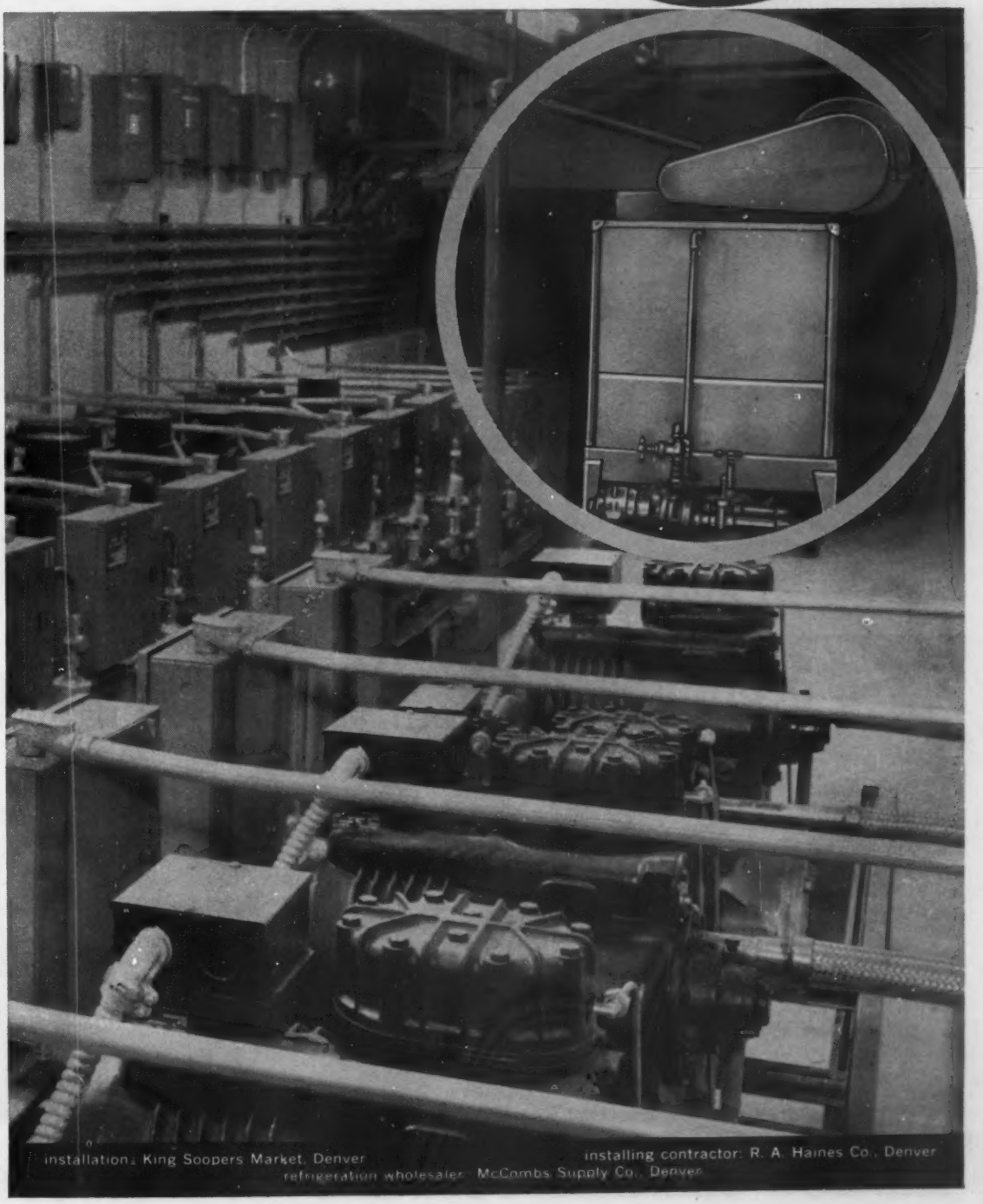


for complete catalog information write:

RECOLD **CORPORATION**

7250 East Slauson Avenue, Los Angeles 22, Calif.

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DOW | INSULATION



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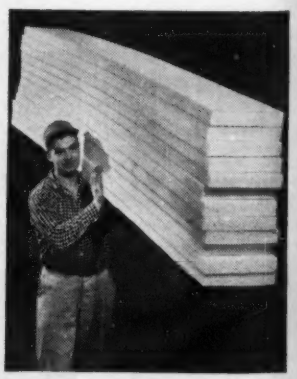
Key to permanently low operating costs

When Styrofoam* insulates low temperature space, the long term costs of operating refrigeration equipment tumble to a new low . . . and stay low, permanently! There's no loss of insulating efficiency with the passage of time, thanks to an unmatched combination of physical properties.

Here's a rigid plastic foam insulation with thousands of tiny, individual air cells in every cubic inch. This cellular structure provides an extremely low "K" factor plus high resistance to the passage of water and water vapor. With Styrofoam there's no water pickup . . . consequently its heat conductivity stays low. And when heat load stays at virtually the same low level over years of service, your equipment operating costs stay uniformly low, too!

And here's another important factor in low operating costs. Because Styrofoam won't freeze, swell or crack — won't permit ice formation, often the cause of buckled insulation—there's no need for periodic replacement and your equipment won't have to work overtime removing heat introduced during repair.

For more information, contact the Styrofoam distributor near you, or write THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Sales Dept. 2222JZ12.



*Dow's registered trademark for its expanded polystyrene

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

KRACK *always* delivers rated capacities!

To effectively refrigerate an area of 52,848 square feet the Allegheny Storage Company chose 50 KRACK Model HG-1200-FLA Coolers in their new Pittsburgh warehouse. Rigid specifications had to be met and KRACK met them: initial investment had to be kept to a minimum; uniform temperatures and minimum velocities were a must; operating and maintenance costs had to be kept down—these and many more exacting requirements were fulfilled to the letter by KRACK units!



Model HG-1200-FLA Low Temperature Hot Gas Defrost Product Cooler features a hot gas coil under the drain pan.

Shown above is small section of Allegheny Storage Company's new warehouse designed by Grove, Shafer & Associates, Pittsburgh.

Allegheny Cold Storage Co. of Pittsburgh . . .

. . . stores 18 million lbs. of frozen food at 0°F. and does it ECONOMICALLY with KRACK!

No lost stacking space—
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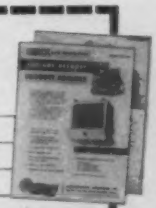
KRACK ENGINEERED REFRIGERATION APPLIANCES, INC

Manufacturers of Freon, Recirculated, Flooded or Direct Expansion Ammonia Heat Transfer Equipment

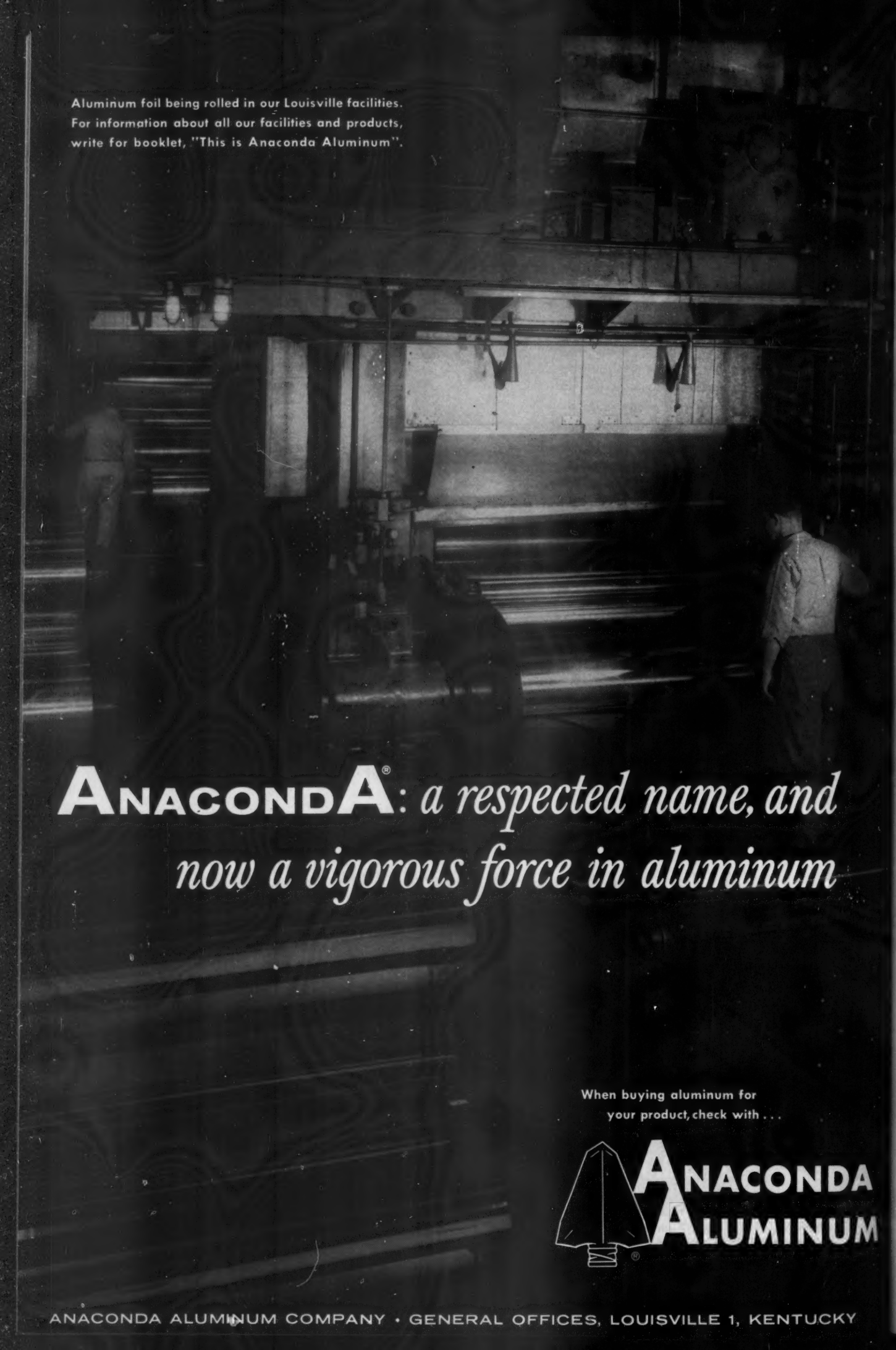
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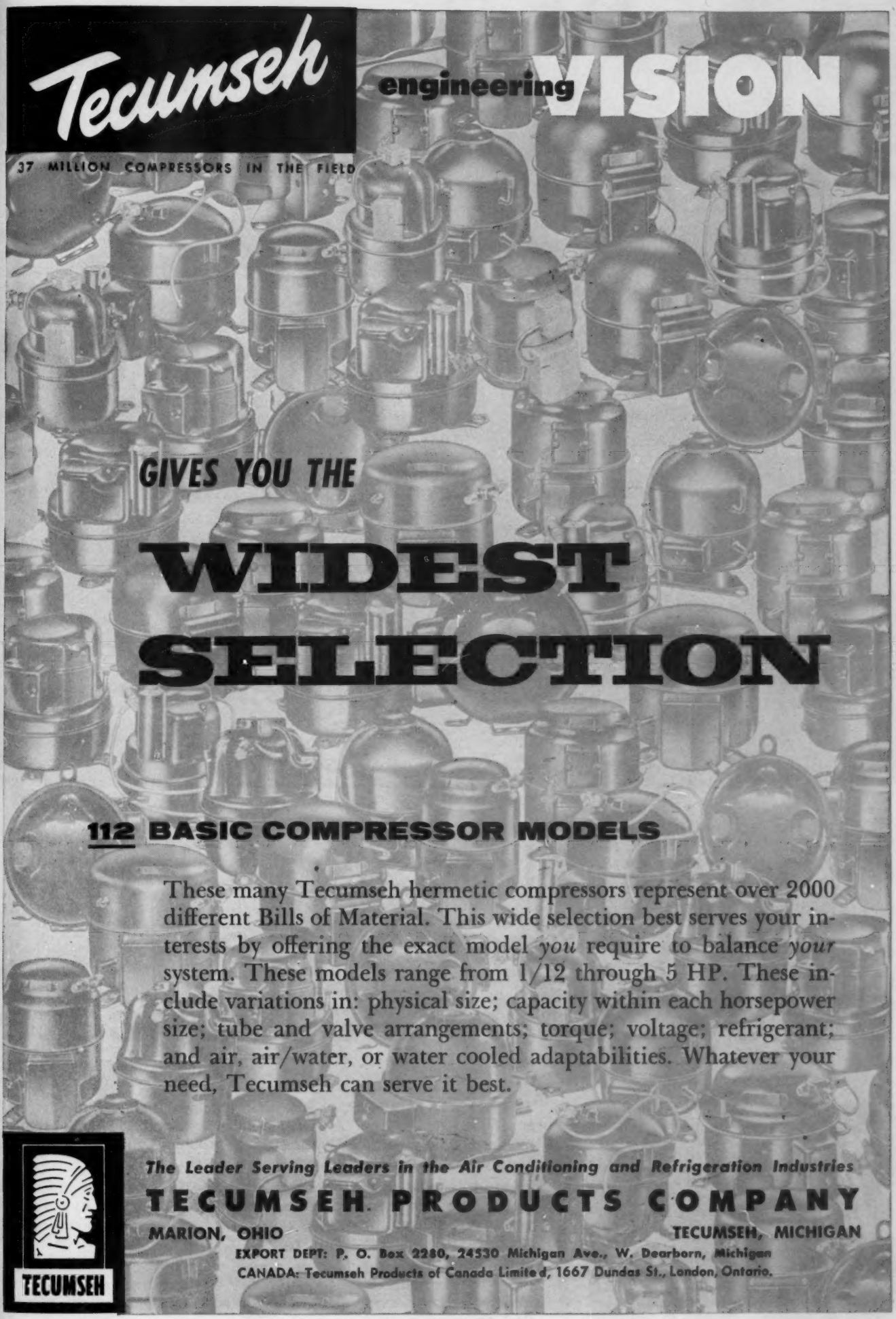
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For information about all our facilities and products,
write for booklet, "This is Anaconda Aluminum".

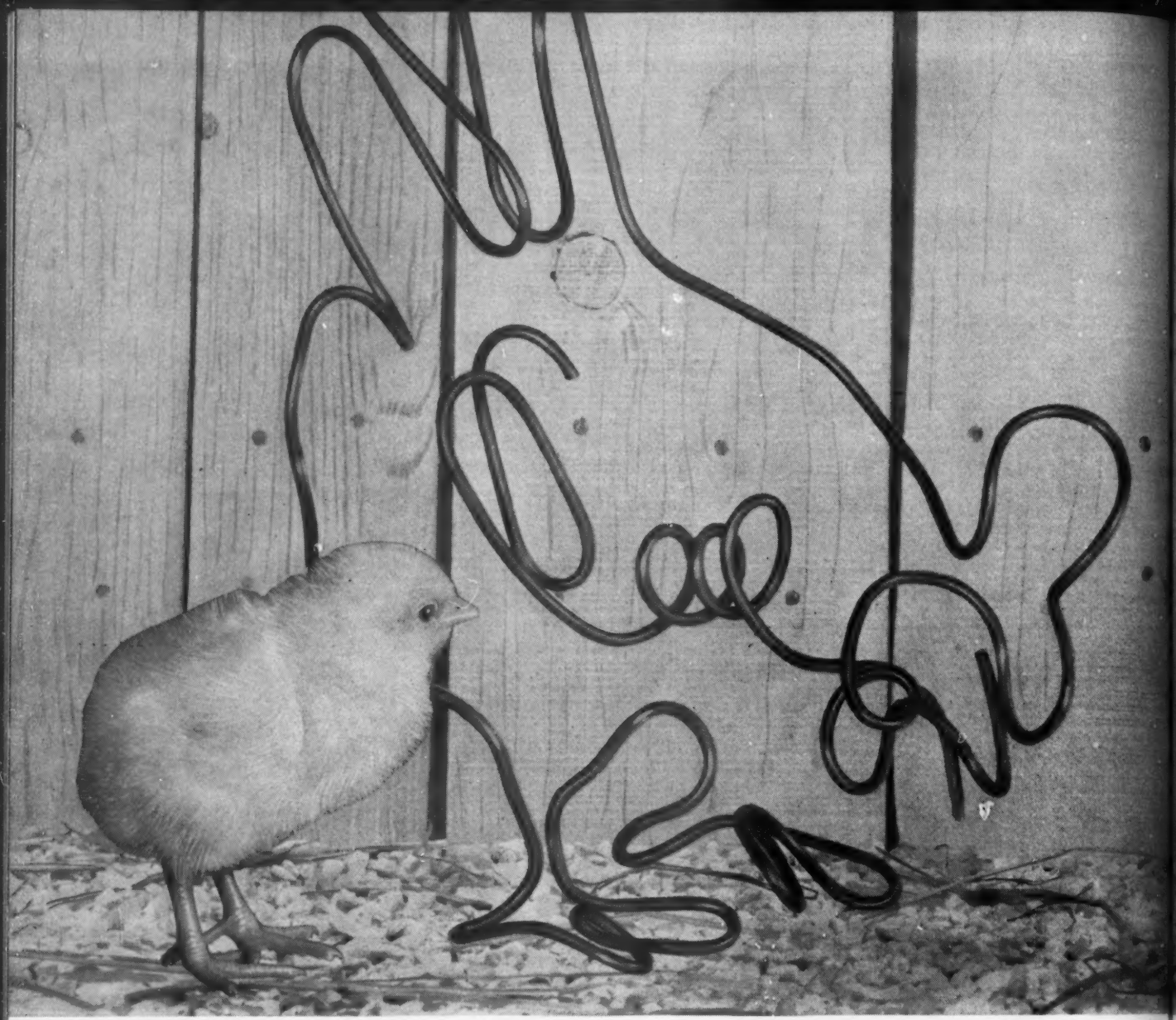
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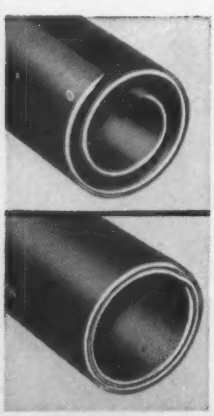
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There's almost no limit to the things Bundy can mass-fabricate



Bundyweld is the original tubing double-walled from a single copper-plated *steel* strip, metallurgically bonded through 360° of wall contact for amazing strength, versatility.

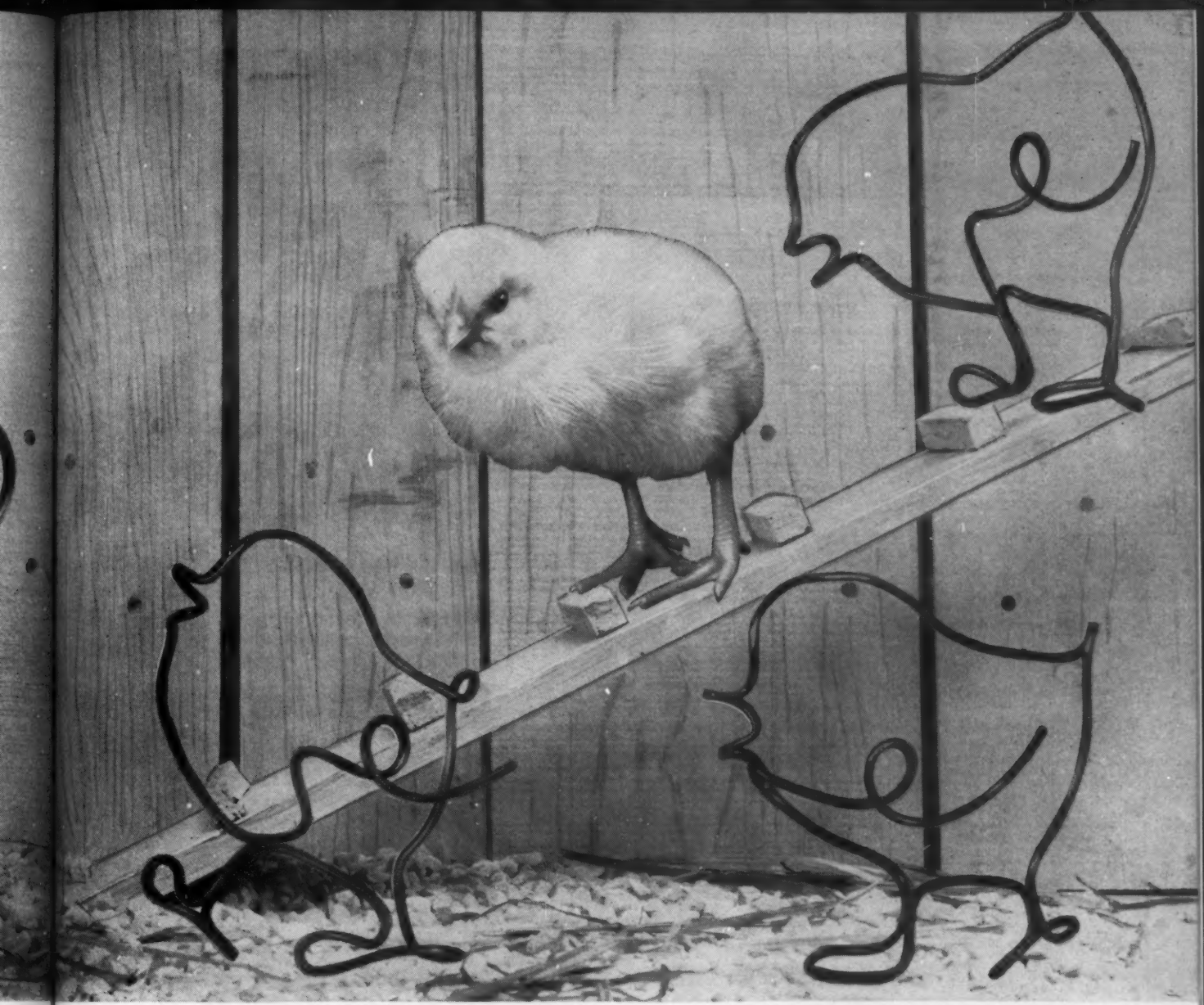
Bundyweld is lightweight, uniformly smooth, easily fabricated. It's remarkably resistant to vibration fatigue; has unusually high bursting strength. Sizes up to ⅝" O.D.

The old adage, "Don't count your chickens before they hatch," is a good one . . . but it rarely applies to Bundy. That's because, no matter how complex your tubing problem, you *can* count on Bundy for the perfect solution.

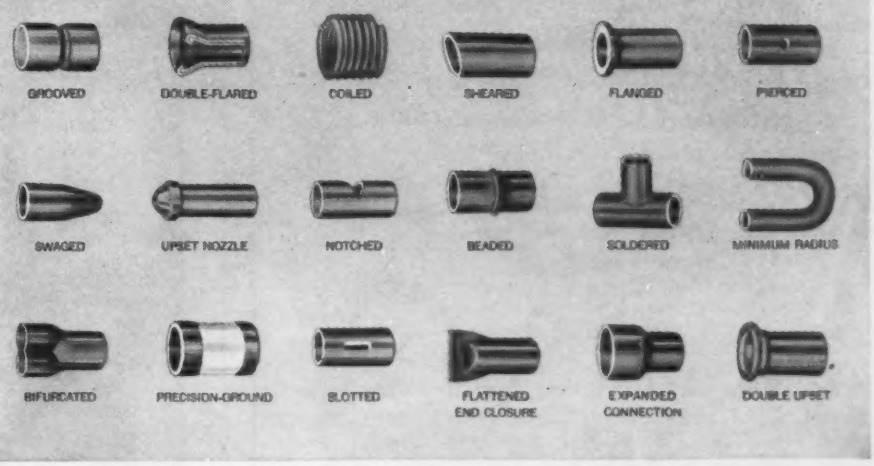
Bundy engineers and designers are backed by years of experience in the mass-fabrication of steel tubing. And they are available to you at any stage of product development for time- and money-saving suggestions. Their key: Bundyweld®!

Bundyweld steel tubing is double-walled, copper-brazed, leak-proof by test, and the safety standard of the refrigeration industry. Beveled edges provide smooth inside and outside seams. No inside flash to be removed.

So, when you want to talk tubing, talk to the leader—Bundy! Phone, write, or wire Bundy Tubing Company, Detroit 14, Michigan.



No matter what type of mass-fabrication you require, Bundyweld may be your answer. Shown here are just a few tubing operations designed and fabricated by Bundy—many for use in the refrigeration industry.



There's no substitute for the original

BUNDYWELD® TUBING

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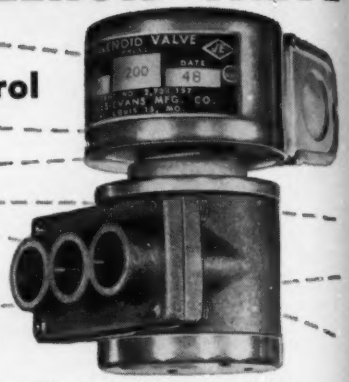
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for flow control of hot or chilled water with fan-coil units



This New addition to the J-E Line provides–

- Economical temperature control.
- Separable solder flange for easy installation.
- One size for ½ to 10 gpm for simple selection

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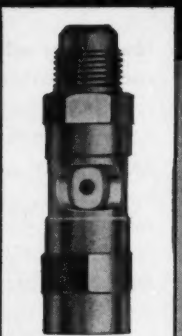
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POSITIVE SEALING INDICATORS

. . . your sign of DEPENDABILITY and QUALITY

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● Pyrex glass, double pressure sealed at sides and ends. ● Positive check of refrigerant condition. ● Unrestricted full line flow. ● Spring-loaded gaskets insure positive seal against leakage. ● Guaranteed to 500 psi. ● Precision made.

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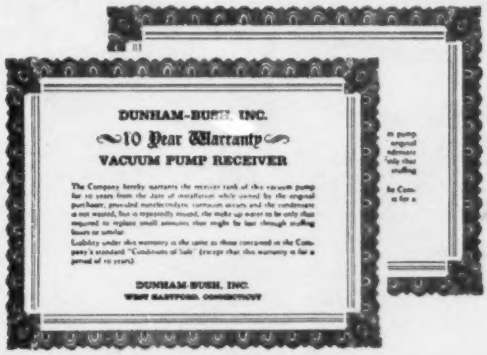
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410 N. Hermitage Ave. • Chicago 22, Illinois
Over 1,000,000 Liquid Eyes Sold to Date!

Dunham-Bush Issues 10 Year Pump Receiver Warranties — Reaffirms Continuance of Quality Product Lines

Recognizing a general industry trend to put price in a paramount position and inherent dangers of quality control in such a concept, Dunham-Bush has taken this step.


DUNHAM-BUSH, INC.

10 Year Warranty

VACUUM PUMP RECEIVER

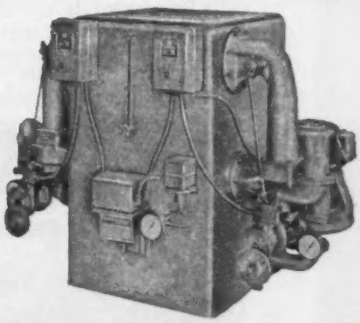
DUNHAM-BUSH, INC.
WEST HARTFORD, CONNECTICUT

Pioneering in the interests of specifier, installer and owner, Dunham-Bush has issued a ten year warranty on their vacuum pump and condensate pump receivers. This warranty is a clear cut expression of the manufacturer's confidence in their product performance and willingness to back up this expression of confidence with a written warranty.

The Dunham-Bush ten year warranty reads as follows: "The Company hereby warrants the receiver tank of this vacuum (condensate) pump for ten years from the date of installation while owned by the original purchaser, provided nonelectrolytic corrosion occurs and the condensate is not wasted, but is repeatedly reused, the make-up water to be only that required to replace small amounts that might be lost through stuffing boxes or similar.

Liability under this warranty is the same as those contained in the Company's standard 'Condition of Sale' (except that this warranty is for a period of ten years)."

Attesting to an integrity of manufacturing that has guided the Dunham-Bush product lines since 1903, this latest step insures continued quality with today's modern production and pricing methods.



The Dunham-Bush vacuum and condensate pumps with copper bearing steel receivers, offer many outstanding features for dependable and economical operation.

A Complete Dunham-Bush Vacuum Pump Line

Type VR, Model C2. Single Unit. 2500 through 20,000 EDR.

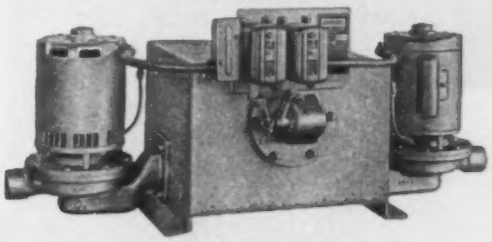
Type VRD, Model C2. Duplex Unit. 2500 through 20,000 EDR.

Type VR, Model B2. Single Unit. 25,000 through 65,000 EDR.

Type VRD, Model B2. Duplex Unit. 25,000 through 65,000 EDR.

How Simple Two Cycle Operation Works

One simple moving element—the pump impeller—(1) forces water through the exhauster, creating a vacuum for constant circulation of steam, vapor and condensate through the heating system piping, and (2) creates a positive pressure for delivering condensate to the low pressure boiler.



Positive Condensate Removal

Dunham-Bush pumps efficiently handle hot condensate at above normal rates assuring dependable operation under all conditions. Efficiency and capacity are not dependent on close tolerance of parts. This means continuous, trouble-free operation. On all duplex pumps, automatic stand-by service is standard. Fuel is saved by returning hot condensate to boilers rather than wasting to sewers. This reduces amount of make-up water and minimizes difficulties from boiler incrustation and system corrosion.

2,000 Through 50,000 EDR Range

Dunham-Bush Type CHV pumps are manufactured in capacities of 2,000 through 20,000 EDR with discharge pressures at 15 and 20 pounds.

Type CH pumps provide capacities 2,000 through 50,000 EDR with discharge pressures from 10 through 70 pounds and are designed for heavy-duty applications.

Product Data Available

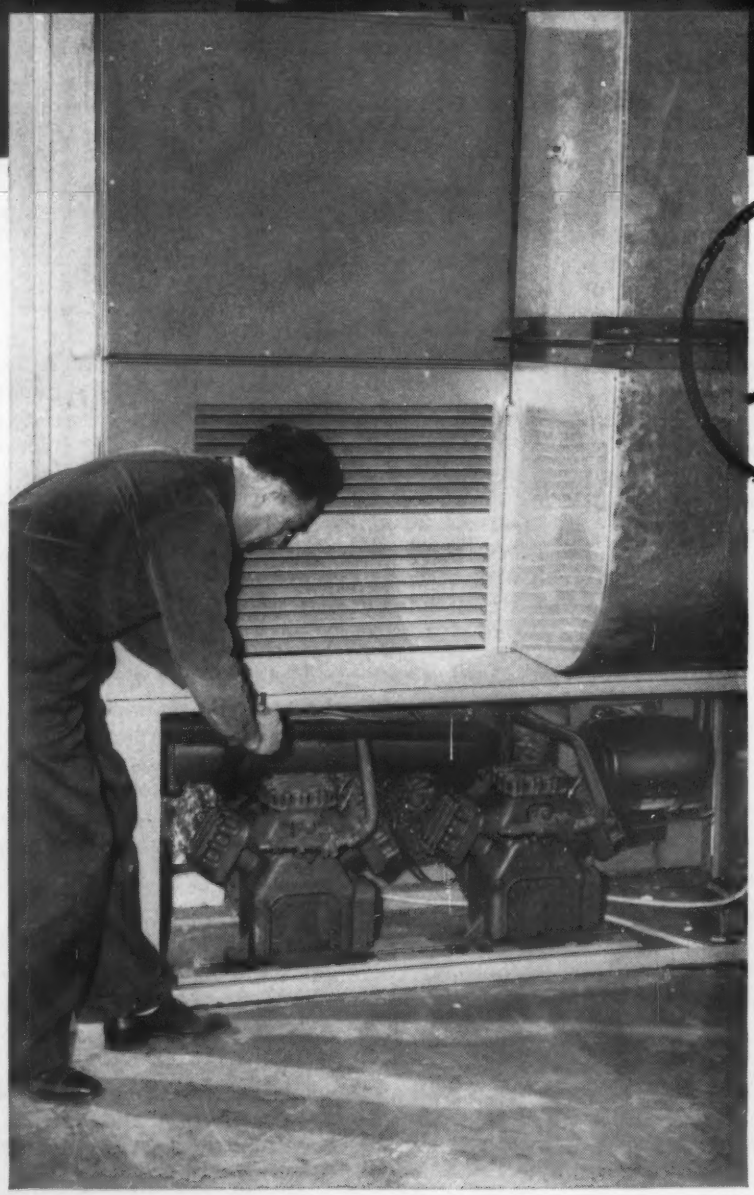
File 1401 B gives complete Dunham-Bush vacuum pump specifications and data. Form 1403 details the condensate pumps. Sample Warranty available for inspection. Request direct from manufacturer.

Dunham-Bush, Inc.

AIR CONDITIONING, REFRIGERATION,
HEATING PRODUCTS AND ACCESSORIES

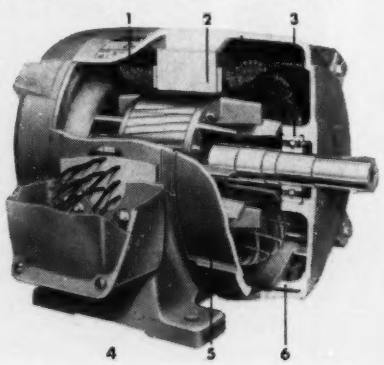
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JOB TESTED

1. Fortified insulation lasts longer; resists moisture, oils and chemicals 2. Unitized stator gives better electrical performance 3. Pre-lubricated bearings eliminate on-the-job greasing 4. Precision manufacturing produces smooth, quiet operation 5. Armorized frame shrugs off physical abuse, stands up to attacks of foreign elements 6. Drip-proof ventilation gives complete protection *regardless* of mounting position.





Westinghouse Life-Line A motors customer approved for air conditioning

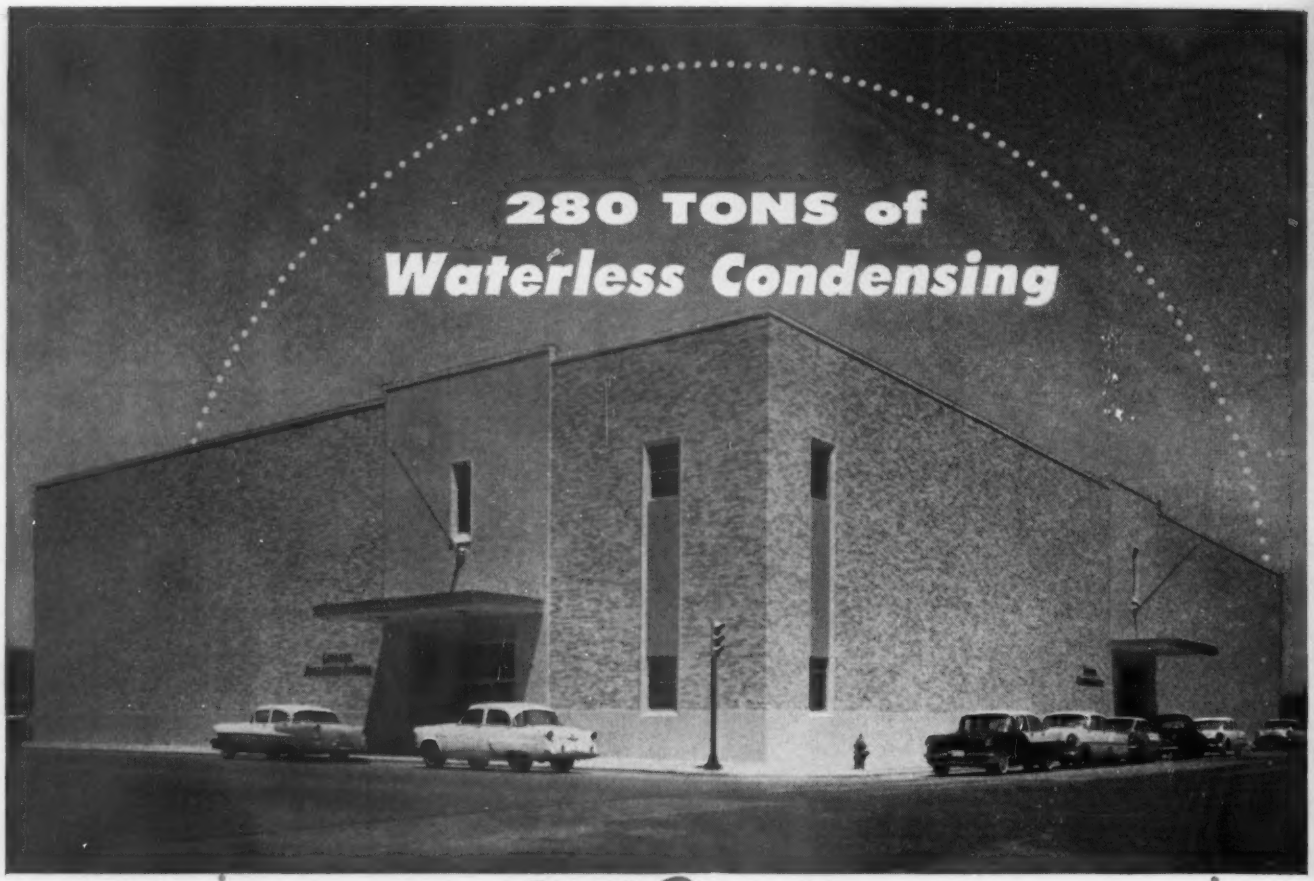
Westinghouse Life-Line® "A" motors have been thoroughly tested in tough air conditioning jobs throughout the country . . . and proved *outstanding* for rugged performance, dependability and extremely quiet operation.

Precision manufacturing and dynamic balancing of this Westinghouse motor have produced the quietest operating unit available. Tests in soundproof laboratories prove this Life-Line "A" motor produces an operating sound level lower than other standard motors.

Armorized frame provides rigidity to prevent armature misalignment even with heavy shaft loads . . . protects motor from physical abuse and contamination. Ventilation openings in the end brackets make the Westinghouse motor *completely* drip-proof, regardless of mounting position. Life-Line "A" 4-way sealed, prelubricated bearings keep grease in . . . dirt and water out . . . eliminate on-the-job greasing in out-of-the-way applications.

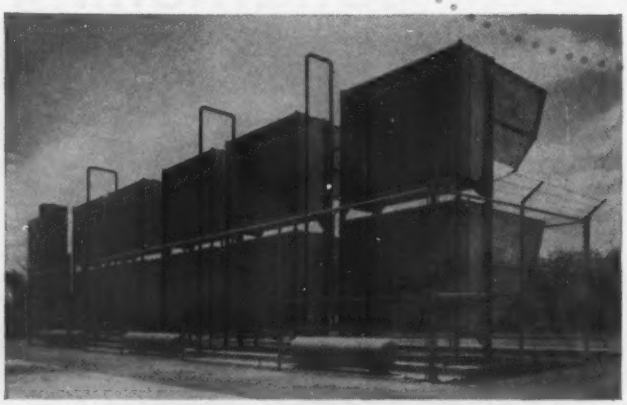
For complete information, call your local Westinghouse distributor or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-22004

YOU CAN BE SURE... IF IT'S Westinghouse



The Avalanche Journal Building, Lubbock, Texas. W. A. McMillan, Architects; Hedrick and Stanley, Engineers; Anthony Co., Mechanical Contractors.

with McQuay AIRCONS for this Texas Newspaper Plant



Remote McQuay horizontal air flow Aircon installation with wind deflectors at Avalanche Journal Building, Lubbock, Texas.

IN LUBBOCK, TEXAS, where the weather is both hot and dry, and water is a problem, this bank of 10 McQuay Aircons furnishes 280 tons of refrigerant condensing for the new plant of the Avalanche Journal.

Engineers and architects like McQuay Aircons because of their flexibility and their operating and installation economy. McQuay Aircons are made in 8 models from 7½ to 75 tons capacity in a single unit in either vertical or horizontal air flow models. Unlimited capacity is available in multiple unit installations.

You not only get more models and more capacity, you get more performance, because McQuay Aircons have the exclusive Mc Quay Ripple-Fin coils—the finest and the standard of the industry.

The McQuay "Seasontrols", automatic head pressure controls, are available as accessories, and modulate the condenser capacity in accordance with the weather for proper operation at all times. For complete information, call the McQuay representative in or near your city, or write McQuay, Inc., 1606 Broadway Street N.E., Minneapolis 13, Minnesota.

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AIR CONDITIONING • HEATING • REFRIGERATION

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SALES ENGINEER—Pittsburgh Plate Glass Co. has excellent opportunity for graduate M.E., Ch.E., C.E., or Bus. E. Fiber Glass sales engineer to do product application work with manufacturers in thermal and acoustical insulation fields. Position involves no sales but requires constant customer and internal division contact in an engineering capacity. Some travel; downtown Pittsburgh location. Send detailed resume to Mr. R. R. Esler, Industrial Relations Dept., One Gateway Center, Pittsburgh 22, Pa.

REFRIGERATION SALES ENGINEER—Rapidly expanding, established West Coast-headquartered industrial refrigeration manufacturer offers opportunity for aggressive sales engineer. Must have engineering degree or equivalent; minimum of 3 yr refrigeration sales engineering experience in quick freezing, cold storage and process refrigeration. Excellent salary, commission, outstanding company benefits, car allowance and expenses. Send detailed resume or phone C. R. Kohlenberger, Pres., Kohlenberger Engineering Corp., 1600 W. Commonwealth Ave., Fullerton, Calif.

REFRIGERATION ENGINEER—For manufacturer of air conditioning equipment. Must be experienced in component selection and system design. Background knowledge of sheet metal manufacturing helpful. Salary range $8,500 to $10,500. Position Assistant to Chief Engineer. Medium size well rated manufacturer, middle Atlantic States location. Send resume of background, education, experience; include recent earnings. All replies confidential. Our employees know of this ad. Box 915 ASHRAE JOURNAL.

CABINET ENGINEER required for home freezer department. Must be familiar with production techniques in metal fabricating industry, tooling, and materials used in refrigerators and freezers particularly plastics. 3 to 5 yr experience, state qualifications and salary requirements. Replies in confidence. Location: Southwest. Box 917, ASHRAE JOURNAL.

MANAGER of Air Conditioning Engineering to assume management of product design and development of well established eastern manufacturer. Products include packaged equipment, chillers, fan coil units, heat pumps, air handling equipment and some commercial refrigeration. Must have proven technical and administrative ability. Send resume of qualifications to Box 919, ASHRAE JOURNAL.

PRODUCT DESIGN ENGINEER—To develop, design and conduct cost reduction programs on a complete line of air conditioning products. Products include assemblies from 2 ton through 100 ton including chillers; also air handling equipment, evaporative condensers and air cooled condensers. Excellent opportunity for rapid advancement for qualified man. Company located in East. Replies held in strict confidence. Box 920, ASHRAE JOURNAL.

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AIR CONDITIONING, HEATING AND REFRIGERATION ENGINEER—P.E., with B.M.E. and M.M.E. degrees. Desires manufacturers representative arrangement for Metropolitan New York area with progressive manufacturer of air conditioning, heating and refrigeration equipment. Excellent experience in design, application and sales of equipment applicable to all types of mechanical systems. Have contacts and work with mechanical and engineering contractors on technical problems. Box 895, ASHRAE JOURNAL.

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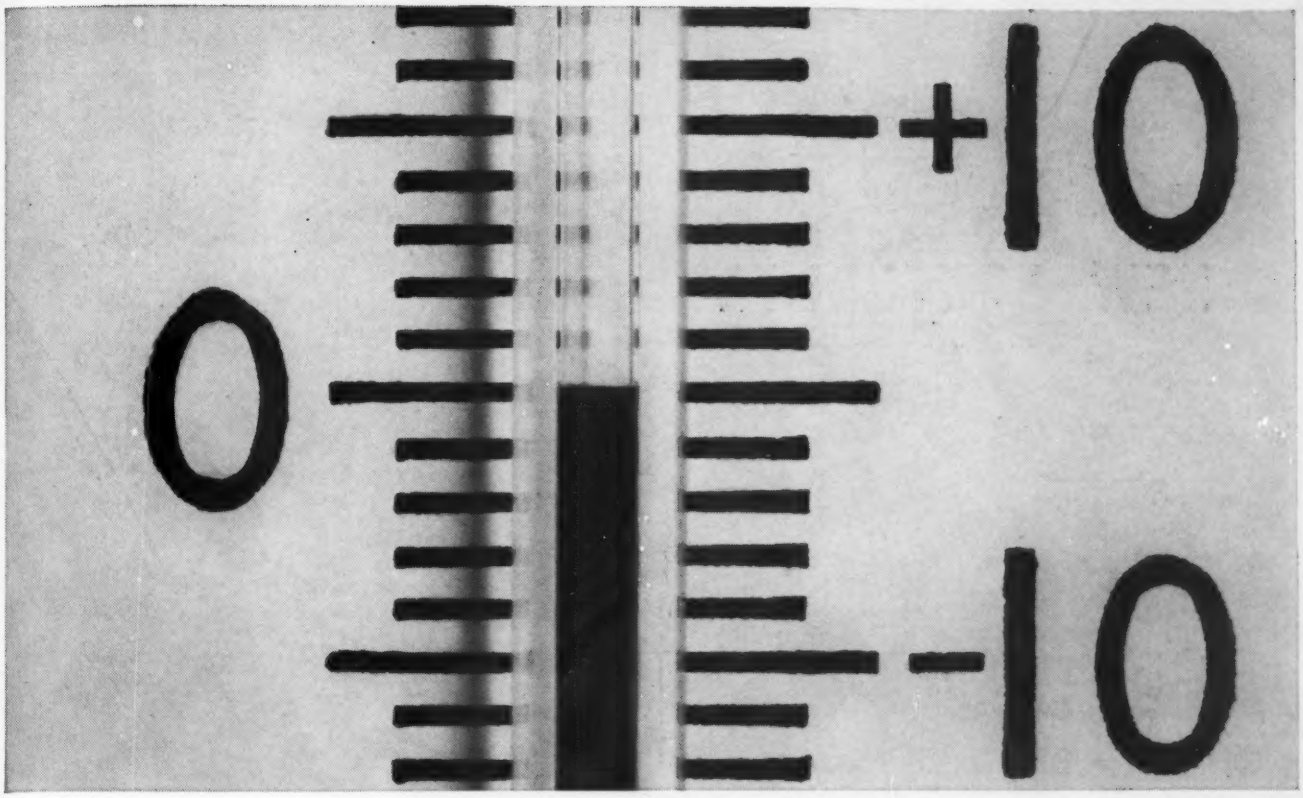
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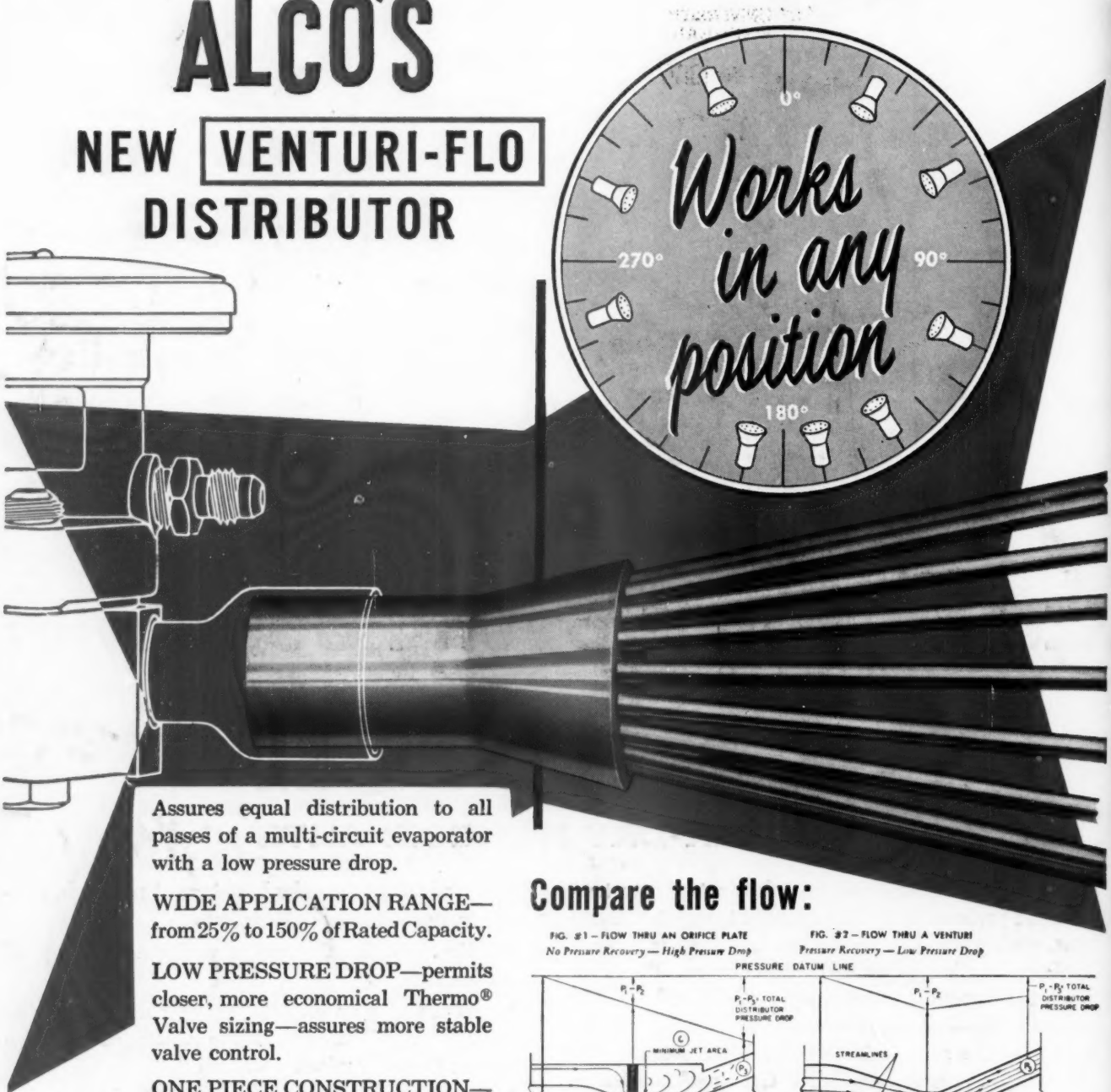
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